THE
Seaman's Tutor:
EXPLAINING
GEOMETRY,
COSMOGRAPHY,
AND
TRIGONOMETRY.
WITH
Requisite TABLES
OF

Longitude and Latitude of Sea-Ports, Traverse Tables, Tables of Easting and Westing, Meridian Miles, Declinations, Amplitudes, Refractions, Use of the Compass, Kalendar, Measure of the Earth's Globe, Use of Instruments and Charts, Difference of Sailing, Estimation of a Ship's Way by the Log, and Log-Line, Currents, &c.

Compiled for the Use of the Mathematical School in *Christ's Hospital-London*, His Majesty *Charles* II, his Royal Foundation.

By Mr. *P. Perkins*, late Master of that Mathematical School.

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To the Right Worſhipful Sir *John Frederick*, Preſident; and Treaſurer and Governors of *Chriſt's Hoſpital, London.*

WHereas *Mr.* P. P. *Mathematical Maſter of the Royal Foundation, deceaſed, left this Tutor of Navigation in great part done, and intended it for that School: it is now finiſhed by his Brother* Eyſum Perkins, *which uſed to teach that School for his ſaid Brother, which for the great*

favours he received of them, humbly presents this Tutor of Navigation.

Your most

Humble Servant

Eyſum Perkins





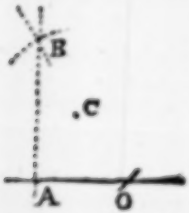
One of the Children Educated in x^t hospit.
Being the kings Royall gift & Founditer

THE
U T O R
T O
Navigation, &c.

Some Principles of Geometry.

FRom a point in a Line given to raise a Perpendicular.

Let A B be a Line given, and A the point raised.

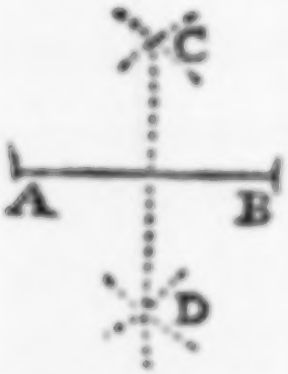


Fix one Foot of the Compasses on any con-

venient point as C, extending another
then turning them; with that Foot at A
an Arch at E, and another at O to cr
Line A, B; afterwards lay a Ruler o
and C, and draw a ſhort Line, cutting
Arch B in E: Laſtly, draw E A, whi
be a *Perpendicular*, as was to be done.

2. To Biſect a Line, or to divide a Line
two equal parts.

Let A B be a Line to be divided.

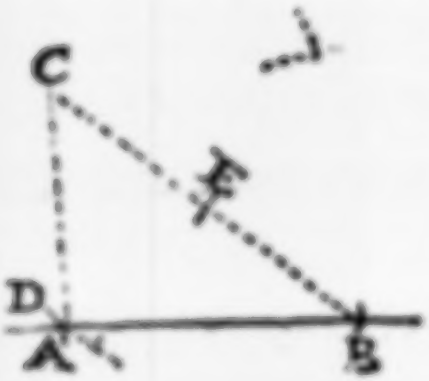


Set one Foot of the Compaſſes in A,
with any extent at pleaſure ſtrike two
Arches, the one above, and the other be
as C and D; then with the ſame extent
ting one foot in B, croſs the two former Ar
es in C and D, then draw the Line C D wh
will divide A B, as was to be done.

3. Fr

. From a point aloft to let fall a Perpen-
dicular upon a Line given.

et A B be a
given, and C
point propo-
d.

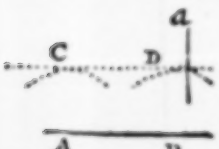


rom C draw a
, as C B,
ch Line di-
into two e-
parts in E;
fixing 1 foot
he Compasses
E, being o-
ed to the extent, C E, or E E, with
other foot describe the small Arch D,
ing the Line A B in A: Laſtly, draw
erpendicular, as was required.

These are the beſt Methods for raiſing and
ing fall Perpendiculars; forasmuch as they
performed without making many, or long
ches or Arches; and they hold, let the
n point be either towards the middle or end
he Line, and are ſufficient for any use with-
any other ways.

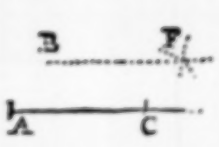
. To draw a right Line parallel to a right
e given at any diſtance aſſigned.

Let A B be a Line given, and a a gi[ven] ſtance at wh[ich] required to Le[t it] Line para[llel] poin[t] A B: with[out] F [de]ſigned diſtance ſetting one [foot] A deſcribe Semi Arch C, and [with] ſetting one [foot] B, deſcribe the [Arch] D: Laſtly, draw a Line juſt to touch [the] of theſe Arches, as C D: then is C D [pa]rallel to A B, and at the diſtance given [as] was to be done.



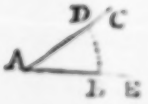
5. To draw a right Line parallel to [a] Line given, that ſhall paſs through [a] given.

Let B be [a] given through [it] its required [to] a Line para[llel] A C. Take the [diſtance] A B, and croſs with ſetting [one] foot in C deſcribe the Arch F: then [with] extent A C ſetting one foot in B [deſcribe] other croſs the Arch F in F: laſtly, [draw] B F, ſo ſhall the Line B F be parallel [to] and paſs through the point B, as was to be [done]

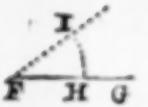


6. To make an Angle equal to an Angle gi-

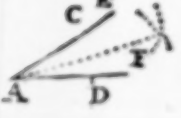
Let it be required at
a point F, and to the
line F G to make an
Angle equal to the An-
gle A E.



Setting one Foot in the
angular point A with a
extent as A B, describe
the Arch B D: then
with the same extent set-
ting one foot in F de-
scribe an Arch as H I:
lastly, take the extent
C D, and prick it from
H to I, and draw F I which shall make an
Angle equal to the Angle C A E as was
to be done.



7. To bisect an Angle. Let D A E be an
Angle given. Setting one
foot in the angular
point A with any
convenient opening
cross the Legs in C
and D, and with the
same or any other con-
venient extent, setting
one foot in C, make with the other an Arch
at F, afterwards keeping the same extent, set
one foot in D, and with the other cross the for-



mer Arch F in F, and draw A F, which divide the Angle, as was required. The F is called a point of Intersection.

8. To divide the Circumference of a into eight equal parts.

First, draw the Diameter A C, then the Compasses opened to any extent, exceed half A C, set one foot in C, and other make an Arch above as at B, and one foot in A, with the other cross the B in B, and through the points B and E the Diameter F E G, will divide Circle into equal parts then again any circle above half setting one on A with other make Arch at L, again fixing foot in F, the other cross the Arch L, and laying a lar over L, and the point E, where the Arches intersect make a mark on the circumference at K, so is A K or E F the $\frac{1}{6}$ of the Circumference.



9. To divide the Circumference of a Circle into thirty two equal parts.

First, Divide it into 8, as above directed, and then divide again each of these parts into four, which is easily done by Bisection.

10. To divide the Circumference of a Circle into twenty four equal parts.

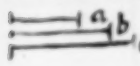
First, Divide it into 8, and then each of these again into 3.

Or, taking the Rad. E C or E A in the compasses, set one foot in C, and with the other make the marks *a*, *b*, on each side C, then with the same extent setting one foot in F, with the other make the marks *c*, d, and fixing one foot in A, make the marks e f, and so in G make g h which shall divide the Circle into twelve equal parts, which being divided again each into two will be 24.

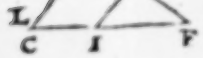
11. To divide the Circumference of a Circle into 360 equal parts.

First, Divide it into 12,as in the last directed, and then each of these into 3, and each of these again into 10.

12. Three Lines being given to find a fourth proportional Line, that is, to find a fourth line which shall be contain'd by, or contain the third, so often as the second is contained by, or contains the first.



Let a b c be three Lines given, make an Ang as the Ang. E F L, and lay the Line a from F to H, and the Line b from F to I, and draw H I: then take the third Line, C, and prick it on the ſame Line the firſt was, from F to K, and by K draw a parallel to H I, as K L, ſo ſhall F L be the fourth proportional required. The ground of this, and of all the Doctrine of Triangles, is the ſide of like Triangles and proportional.



13. Through any three points given, as A, B, C not being in a ſtraight line, to deſcribe the circumference of a Circle.



From the Centers A and B at above half the diſtance of the given points A and B make the interſections D and E, and draw the ſtraight line D E. Again, at above half the diſtance B C, on the Centers B and C make the interſections

Intersections F and G, and draw the straight F G cutting the Line D E in H: Lastly, setting one foot of the Compasses in H, with the other extended to A or E, describe the circumference of a Circle, which shall pass through the three points given, A, B, C.

14. The Diameter of a Circle being given to find the circumference. Say,

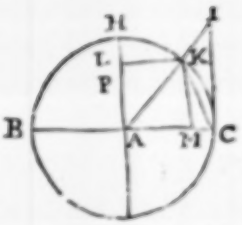
As 7 is to 22, or as 1 is to 3,1416, so is the Diameter to the Circumference.

15. The circumference being given, to find the Diameter. Say

As 22 is to 7, or as 1 is to 0,3183, so is the Circumference to the Diameter.

16. *Of the Circle.*

The $\frac{1}{360}$ part of the Circumference of a Circle is called a degree, each of which are again subdivided into sixty equal parts called minutes, each of which again are imagined to be divided into sixty equal parts, called seconds, &c. to tenths.



A Semicircle

therefore is an Arch of 180 deg. And a Quadrant 90 deg. The measure of an Angle is the Arch of a Circle described on the angular point intercepted between the sides sufficiently produced: so the measure of the right Angle is always 90 deg. And that Angle which contains less than 90 deg. is called an acute Angle, but that which contains more, obtuse.

The Complement of an Arch or Angle is so much as it wants of being compleatly 90 deg. But the Complement to 180 deg. is so much as it wants of 180 deg. which is found by substraction.

The Proportion which the Arches, (being the measures of Angles) have to the sides of a Tri cannot be certainly known, unless by a comparing of Arches with their terminating straight lines; as *Chords*, *Sines*, *Tangents*, *Semitangents*, *Secants*, and *Versed Sines*.

A *Chord* is a right Line subtending an Arch.

A *Sine* is $\frac{1}{2}$ the Chord of the double Arch.

A *Tangent* is a Line touching the Circle in some point.

The *Semitangent* is not half the *Tangent* of an Arch, as some take it to be, but is the *Tangent* of the half Arch.

The *Secant* is a Line drawn from the Centre cutting the Circumference, and is extended to the *Tangent* Line. As

Let

Let K C be an Arch of 45 deg. then

K C is the Chord.
K M is the Right Sine.
M A = L K the Cosine.
M C is the Versed Sine. } of 45 deg.
C I the Tangent.
H I the Cotangent.
A I the Secant.
A P the Semitangent.

A K = A C = H A = E A = C I the Radius or Semidiameter. Note that the Secant of 60 deg. is equal to the double Radius.

Such proportion as the Circumference of one Circle has to another, such proportion have their degrees, Semidiameters, Sines, &c. of like Arches one to the other, and the contrary.

The words Cosine, or Cotangent of an Arch signifie the Sine or Tangent of the Complement of that Arch.

The Sine or Tangent, &c. of an Arch greater than a Quadrant, or 90 deg. is the Sine or Tangent of that Arches Compl. to 180 deg.

The Cosine or Cotangent of an Arch greater than a Quadrant, is the Sine or Tangent of the excess of that Arch above a Quadrant, or 90 deg.

Assigning the Radius A C to be a Unite with Cyphers at pleasure, to express the quantities of these respective Lines, in relation to the Arches to which they belong, is to make a Table of

natural

natural Sines, Tangents and Secants, &c.

Here I cannot pass without letting the reader participate somewhat of the pleasure I have had in contemplating the ancient methods, and how gradually to this time they have been with great labour improved. The Ancients used the natural Chords, the circumference of the Circle being divided into 360 parts, and the Diameter into 120, with each of these subdivided into 60, the sexagenary division being the most convenient then known, and in these they estimated their Chords, a Table whereof you may see in *Ptolemy Alm.* These I say were the only Tables in use, till about the year of our Lord 1430, *Regiomontanus* keeping the same division of the Circumference, divided the Diameter into 10000 equal parts, computing in these the Chords of half arches which he called Sines.

This is the first Decimal Division we find, and makes me believe it was that President that led us to our *Decimal Arith.* But tho *Regiom.* were the first introducer of the Decimal Division of the *Radius*, or whole Sine, yet it was the Saracens or Arabs that first formed and used the Sines instead of Chords, we having from them about the same time the nine useful Characters, which we call Digital Numbers, and their Uses.

Afterwards to these Tables of Sines, *Brissius* added the Table of Natural Tangents, which he

he called Adscripes: and others, as *Vieta*, called them Profines. After which *George Joachimus Rheticus* adds the Table of Natural Secants, which he called Hypothenusas, or Transsinuosas, all which were used with a great deal of labour of common Multiplication and Division, till *Nicholaus Raymarus Dithmarsus* by an Art he called *Prosthaphæresis*, somewhat eased the work: this was improved by *Magirus*'s Tables, where of you may see in his *Primum Mobile*: Yet Calculation remained very troublesome, and few could endure the burthen of it, which indeed was one reason of these profitable and otherwise delightful studies lying dormant, and so few to meddle with them.

But at length, about the Year 1616, happy *Nepair*, Baron of *Merchiston*, amongst other his curious ways of facile computation, as his Bones, &c. hit on those divine numbers the Logarithms, which were perfected by Laborious *Briggs*, to so great a degree, that I may boldly say, there never was any thing both invented, and so perfected in the like space of time.

Logarithms are such as being substituted in the place of Proportional Numbers do retain an equal Difference.

The old way of making them was very laborious, by many extractions of Roots,

The best way yet known is thus,

First, put for the Logarithm of 1, a Cypher; for 10, a Unite, with Cyphers at pleasure;

ſure, for 100, the 2 with as many Cyphers: for 1000, the 3 with juſt ſo many Cyphers: for 10000, the 4 with Cyphers, &c.

Then find the difference between ſome two Logarithms above 1000, that differ by Unity thus; Multiply the two Numbers together, and that product multiply again by 4343144815032518 3896, which laſt product divided by the Arith. Mean between both numbers, the Quotient is the difference required.

As to find the difference between the Logarithm of 1000 and 1001, their product is 1001000, which multiplied by 4343, makes 4347343, which being divided by 1000,5 (which is the half ſum of 1000 and 1001) the Quotient 434 is the difference of the Logarithm 1000 and 1001. Now if to the Logarithm of 1000, *viz.* 3,000000 you add 434 the ſum 3,000434 is the true Logarithm of 1001.

But if you would make your Tables to more than 5 places, it is neceſſary you begin to find the difference of the Logarithm, not of two numbers above 1000, but above 10000.

Having thus found the difference of any two Logarithms difference by Unity, and conſequently ſome of the Logarithms by dividing the difference found, by the Arith. mean between any two numbers difference by Unity, you ſhall have the difference of the Logarithms of thoſe two numbers: Thus, to find the difference between the Logarithm of 150 and

151

151, divide 434 the difference of the Logarithm of 1000 and 1001 by 150,5 the Arith. Mean between 150 and 151 the Quotient 2,3 is the difference required.

Having by this means made a few of the prime Logarithms, the rest are made there from by Addition and Subſtraction, and having made the Canon upward above 1000 to 10000 by conſequence its made for all inferior Numbers. The Sines and Tangents in this Book are the Logarithms of the Natural Sines and Tangents before deſcribed.

To take out of the Tables the Logarithm of any number under four places.

Each Logarithm conſiſts of two parts, the Body of the Logarithm (as one may call it) and the Index, of which the firſt only are in the Tables, and conſiſt of 6 places. The Index or Characteriſtick is put to the left hand of the Tabular Number after it's taken out, and ſeparated from the reſt by a Comma.

The uſe of the Index is to ſhew of how many Figures or Places from Unity, the natural number ſignified thereby doth conſiſt; the other ſix ſhew more exactly the juſt number ſignified by the Logarithm. To take out of the Tables any number under 100. look in the firſt page of the Table, and you'll find every Logarithm plainly ſet down right againſt its proper number. Thus the Logarithm of 1 is 000000; of 2 is 301030, &c.

But

But if you be to find the Logarithm of any number above 100 consisting of three places, but under four look along the Margin of the Table under N, page after page till you find your number, then in the next Column to the right hand, viz. in that which is marked (0) on the top you have the Logarithm.

Thus the Logarithm of

101 is 008600
110 is 041393, &c.

To which annex their proper Indices thus, if the integer place of the Natural, or absolute Number be under 10, annex 0 to the last hand of the 6 numbers thus found in the Table, separating it with a Comma, if the integer places of the natural number be above 10, and under 100, put 1 for its Index, if above 100, and under 1000 give it 2 for the Index; but if above 1000, yet under 10000 its Index must be 3; and all numbers from 10000 to 100000 have for their Char. 4, &c. the Index being always a Unite less than the number of integer places the natural number consists of: so the Logarithm of 2 with its Index is 0,301030, the Logarithm of 102 with its proper Index is 2,008600, and the Logarithm of 110 is 2,041393.

To find the Logarithm of any number consisting of between four and five places.

Note,

Note, that the Table is divided into 10 large Columns, 5 on the right hand page, and 5 on the left: also each of the numbers in the Margin are supposed to be increased by 10; and the figures 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, which are set at the head of each Column, are to be put to the figures in the Margin, to make them a place more; so that in looking the Logarithm of any number above four places, whether, it be whole number, mixt, or Decimal, first look for the three first figures down along the left Column under N, page after page till you find it, then look right against it Column after Column till you come under your fourth figure, which you must look on the top of your page, then in the common Angle is the true Logarithm of your number, annexing the proper Index as directed. But here note, that the Index is always according to the integer places, or places of Integers, if any, and not at all according to the Decimal Parts. But if the natural number be wholly Decimal Fractions, then put its Index according to its most left hand figures place from the place of Unites.

Thus the Logarithms of

2753 is 3,439806
546.8 is 2,737819
30.54 is 1,484869
4521 is 0,655736

0.3105 is 1,492861
0.003105 is 3,492062.

To find the Logarithm of any number between 10000 and 100000, you must first seek the Logarithm of the four first places as before directed, taking notice of the difference that ſtands in the moſt right hand Column under D, with this difference enter the Table of proportional parts, which are at the end of the Logarithm, and there directly againſt that number, and under your fifth Figure you have a proportional number, which being added to the Logarithm of the firſt four places, makes the complete Logarithm of your number. If the Logarithm of 35786 be ſought, firſt ſeek the Logarithm of 3578, which will be 553649, and the common difference under D 121, with this difference enter the Table of Parts proportional, and find 121 in the firſt Column under D, and then againſt that number, and under 6 the laſt figure of the laſt place of the number 35786, found at the head in the ſeventh Column you will find 72, which added to 553649, makes 553721, to which prefixing its Index 4, you have 4, 553721 the Logarithm of 35786; but if the number had been 3578.6 the Logarithm had been 3,553721, if 357.86 the Logarithm had been 2,553721; if the natural number had been 35 786, the Logarithm had been 1,553721, and if 3.5786, the Logarithm,

Logarithm 0,553721, &c. so that the Logarithm is the same, but the Index alters according to the place of the first, greatest, or most left hand figure.

To find the number answering to any Logarithm given; omitting the Index, seek the other six figures in the Table of Logarithms, and if you cannot find them all exact, take the neatest, then are the numbers in the Margin with that other figure over-head the natural or absolute number.

The Logarithm 3, 544821 omitting the Index 3, I find 544821 to answer 3506, and the Index shews there are to be four integer places, therefore they are all integers: so the Logarithm 1,544821 looked in the Table would give 3506, that is, 35.06 and 1,544821, 0,3506 all Decimal Parts.

If the Logarithm cannot be exactly found, and yet you desire to have the natural number to five places, first find the number to 4 places as before, noting the common difference under D on the right side, and taking the difference betwixt the Logarithm given, and the next less Logarithm found in the Table, then seeking the common difference in the Table of proportional parts, in that Line find out the difference of the Logarithm, and over-head you have the fifth Figure.

To exemplifie in the Logarithm 2, 543612, the Logarithm next less is 543571 answering

to

to 3496, the common difference is 124, the difference of the Logarithm 1541, which in the Table of proportional parts against 124 gives 3, so that the natural number is 34963, and because the Index is 2, is 349.63.

To find the Sine or Tangent of any Degree and Min.

If the Degree be less than 45 deg. look it on the head of the Table, and the minutes down the left Column under M: but if the Degree be above 45, look it at the bottom or foot of the Table, and look the minutes upward in the Right-Hand Column, and in the Column distinguish'd by the Title of Sine, or Tangent, or Cosine or Cotangent (at the bottom or top according as the Degree is) right against the min. you have the Sine, Tangent, or Cosine sought for.

Suppose you were to find the Logarithm, Sine or Tangent of 32 deg. 12' look for 32 deg. at the head of the Table, and down the left hand Column under M for 12', then right against 12 minutes under the word *Sine* at the head of the Table you shall find 9,726626 which is the Logarithm Sine of 32 deg. 12', and against 12 under (*Tang.*) you have 9 789157, the Logarithm Tangent of 32 deg. 12'.

Suppose you were to find the Sine or Tangent

gent of 37 deg. 47′. look 37 deg. at the head of the Table, and upon the Right-hand Page, (because the minutes exceed 30) in the Column under M, you muſt look for 47′ and againſt 47′ and under (*Sine*) at the head of the Table you will find 9,7871232 the Sine of 37 deg 47 and againſt 47, and under (*Tan.*) you'll find 9,889421 the Tang. of 37 deg. 47′.

Admit you were to find the *Sine* or *Tangent* of 64 deg. 15′. Turn to 64 deg. at the bottom of the Table, and upon the Right Hand Page in the Column over M look upwards for 15, againſt 15 and over (*Sine*) at the foot of the Table, you'll find 9,954579 the Sine of 64 deg. 15′, and againſt 15′, over (*Tang.*) you'll find 10,3156644 the *Tang.* of 64 deg. 15′, alſo againſt 15′ over (*Coſine*) you'll find 9,637935 the Sine Compl. or Coſine of 64 deg. 15′.

Suppoſe you were to find the Sine or Tangent of 78 deg. 55 min. Turn to the 78 deg. at the bottom of the Tables, and upon the Left Hand Page (becauſe the min. exceeds 30) over M look for 55 min. againſt which, and over (*Sine*) you'll find the Sine of 78 deg. 55 min. to be 9,991823, and the Tangent in the ſame Line over *Tang.* to be 10,707987, and the Cotang. in the ſame line over *Cotang.* to be 9,291013.

To find the Sine or Tang. of any number of Degrees and Minutes, exceeding 90, ſubſtract them

them from 180 deg and look the Sine, Cosine or Tang of the reſt, as above directed, as to find the Tang. of 153 deg. 7 min. its compl. to 180 deg. is 26 deg. 53 min. which looked in the Table gives under the Title *Tang.* 9,704576 for the Tang. of 153 deg. 7 min.

To find the Sine or Tangent of any Degrees and Minutes above 180, but under 270, ſubſtract 180 there from, and look the Sine or Tangent of that remain'd; as

To find the Sine or Tangent of any number of Seconds under a minute. From the Sine or Tang. of 1 min. ſubſtract the Logarithm of 60, and to the Remainder add the Logarithm of the number of Seconds given.

Admit the Sine of 14 min. were required.

The Sine of 1 min. is	6,463726
The Logarithm of 60 is	1,778151
The Remainder	4,685575
The Log. of 14	1,146128
The Sine of 14 min.	5,831703

A Sine or Tang. being given, to find the Degrees or Minutes anſwering thereto, if it be Sine leſs than 9,8494, or a Tang. leſs than 10,0000, then its a Sine or Tangent leſs than 45 deg. and is to be ſought in thoſe Columns noted with the words (*Sine Tang.*) on the head

head of the Table. But if the Sine or Tang. exceed these respective Numbers, then the Degrees answering thereto are more than 45 deg and are to be found in those Columns marked (*Sine, Tang.* at the bottom: as

Let it be required to find the Arch answering to this Sine 9,645632; this being less than 9,8494. I run over the Columns of Sines, that have (*Sine*) writ on the head, and under 26 deg. and against 15 min. I find the nearest number to my given Sine.

Admit again I were to find the Degree and Min. corresponding to this Tang. 11,276451, this being greater than 10,000000, I look over the Columns of Tang. marked (*Tang.*) at the bottom of the Table and over 86 deg. and against 58 min. I find the nearest, therefore the nearest Degree and Min. answering, are 86 deg. 58 min.

To multiply one number by another; by the Log.

Add the Logarithms of the Numbers, and the Sum is the Log of the Product.

To divide one number by another, is to substract the Logarithm of the Divisor from the Logarithm of the Dividend.

Three numbers being given to find a fourth proportional by the Log.

Add the Logarithm of the second and third numbers together; and from that Sum substract the Logarithm of the first, then is the remainder

the

the Logarithm of the fourth Number sought.

To extract the Square Root of a Number: Halve the Logarithm of the Number, or divide it by 2, and the quot. is the Log. of the Root. But to extract the Cube Root, divide the Logarithm of the given number by 3, and the quot. is the Log. of the Root.

Of Triangles in general.

1. A Triangle is a Figure comprehended of three sides: and is either Plain or Spharical.

2. A plain Triangle is that which is described on a plain Surface, and if its three sides be right Lines, it's called a right lined plain Triangle; and that is again either right angled, or oblique angled; and the oblique, is either obtuse or acute.

3. Any one side of a right-lined plain Triangle is less than the sum, and greater than the difference of the other two sides.

4. All the three Angles of every right lined plain Trian. is equal to 180 deg. or a Semicircle: therefore if two Angles of a Triangle be known, the third is also known, being only the Compl. of their sum to 180 deg. Also if one Angle be known, the sum of the other 2 is known only by substracting from 180 deg.

5. Any one side of a right lined plain Triangle being continued, the exterior Angle is equal to the two interiour Angles opposite.

6. A

6. A plain right angled Triangle hath one right Angle which is equal to both its other Angles, and therefore are neceſſarily the Complements one of the other, ſo that the one being known, the other is alſo known.

7. In a right angled plain Triangle, the Sum of the Squares of the Sides containing the right Angle is equal to the Square of the Hypothenuſal.

The Doctrine of plain Triangles, Trigonometria, or the Doctrine of Triangles teaches the manner of computing the Sides and Angles of Triangles, from certain *data*.

In every Triangle are ſix parts, three Sides, and three Angles.

In a right angled Triangle are given two beſides the right Angle, and in an oblique Triangle are given three of theſe parts to find a fourth.

But note, that the 3 Angles are not ſufficient to the Sides, they give no proportion of the Sides. Any one of the Sides of a right angled plain Triangle may be made the *Radius* of a Circle, and then the other Sides will be Sines, Tangents, or Secants of Angles, and what proportion the Side put, as *Radius* hath to the *Radius*, the ſame hath the other Sides, to the Sines, Tangents, or Secants by them repreſented. From hence are deduced the two firſt following Axioms.

Axioms for the solution of all plain right-lined Triangles.

1. In any plain Triangles the Sides are directly proportional to the Sines of their opposite Angles. *And the contrary.*

2. In the right-angled Triangles, as one Leg is to the other: so is the *Radius* to the Tangent of the Angle opposite to this last Leg. *And the contrary.*

3. In any plain right-lined Triangle, as the sum of any two sides is to their difference, so is the Tangent of the half sum of their opposite Angles, to the Tangent of their half difference, and the sum of the $\frac{1}{2}$ sum and $\frac{1}{2}$ difference is the greater: therefore if two Sides and the Angle included be given, the rest from hence will be known.

4. As the Base is to the Sum of the other two Sides; so is the difference of those Sides, to the difference of the Segments of the Base.

Note that in stating the Cases of Triangles, if a Side be sought, you put the *Radius*, or an Angle first: but if an Angle be required, put a side first.

These four Prop. resolve all plain Triangles.

Of

Of the World.

All the glorious ſpangled Canopy of Stars we ſee with the Earth, and whatever elſe is contained therein is called the *world*, which tho to us ſeeming ſo vaſtly extenſive and great, is but a very ſmall part of the Univerſe.

This Canopy, or admirable Concameration (not reſpecting the Earth, which is a part, when we call it World) is called **Heaven.**

Of the Heaven and Stars.

The Stars are of two kinds, Fix'd and Movable.

The Fix'd always keep at the ſame diſtance and poſition one from the other, and are farther known from the movable by their twinkling.

The Movable are either ſuch as move regularly, and according to a known order, and are called Planets, or irregular, whoſe way and rate of moving nothing can be ſaid of, till the Star is ſeen: theſe are called Comets and Blazing Stars.

The fix'd Stars being many thouſands are for inſtruction's ſake nominated by Parcels, or Conſtellations, to which are given the names of

Men, Birds, Beasts, or somewhat else, as it pleased the Ancients. Of these Constellations there are about 60, the Stars in them being some bigger, and some lesser, according to their Rates or Magnitude, those of the first Rate being the very biggest of all we see; the second are of the size of those 7 well known ones in *Charles's wain*; the third of that of the Pole Star. Within this Sphere of Fix'd Stars are contained the Planets, Earth, and Sun, the Sun being fix'd, and as the Center, round which the Planets move.

These Planets are either Primary, which move about the Sun, as their common Centre, the nearer swifter, and the remoter slower, according to their distances from him: Or Secundary, which move about the Primary as their proper Centre, as our Moon about the Earth, and both together about the Sun.

The Primary Planets are six.

♄ *Saturn*, the farthest from the Sun.

♃ *Jupiter*, the next.

♂ *Mars* moves within the Orb of *Jupiter*.

♂ The Earth within that of ♀.

♀ *Venus* is the next to the Earth.

☿ *Mercury* is the innermost next the Sun. So that the Earth is between the Orbs of ♂ and ☿.

Tho the Earths annual Orb be very large compared with its own Diameter, yet if com-

pare

pared with the vast distance at which the Fixed Stars are placed without it, the Angle it subtends is hardly sensible. So that in what part soever of her Orb the Earth is, she is nevertheless to appearance, and the sharpest scrutiny of sense, in the Centre of the Starry Heavens; and Lines produced from her Centre to each Star, or point in Heaven, or to all the points in any Circle in the Heavens, shall design the Star-points, or Circle on the Earth's surface.

Of the Body or Mass of Earth and Water.

That it's a Globe, and has a property of attracting all it's parts, or it's parts a tendency, called weight, towards it's middle point or Centre, and that upward and downward are terms only respecting the Center, or said middle point of the Earth, I shall not need to insist upon, they being common, and well known notions already apprehended by most people.

This Globe of Earth and Water has two points directly opposite the one to the other, that constantly inspect the same parts or points of the Heavens, which points are called Pole, as are also those points in the Heavens inspected.

A line passing through the body of this Globe

from one Pole to the other, and also passing the Center, is called the *Axis*.

Imagine a Circle to girt this Globe of Earth and Water round in the middle between the two Poles, so that the plain of the Circle may be at right Angles to the *Axis*; this Circle is called the Equinoctial Cycle or Line, and it being the principal Line of use among Seamen, they often omit the word Equinoctial, calling it *the Line*. A Circle right over this in the Heavens is called by the same name.

Again imagine Circles to pass from one Pole to the other through as many degrees or points of the Equinoctial, as you please, these Circles are called *Meridians*.

The Circle you see in a clear day where the Sky and Sea seems to meet all round is called the visible *Horizon*, parallel to which at the distance of the Earth's Semidiameter is the *true Horizon*.

The point in the Heavens directly over your head in all places, is called the Zenith, and the point under the feet is called the *Nadir*, and are each of them 90 degrees from the Horizon.

Now again imagine Circles to be described in the Heavens round the Globe, all meeting in the Zenith and Nadir, as the Meridians do in the Poles, and to cut the Horizon at right Angles as the Meridians do the Equinoctial.

These Circles are called *Azimuth Circles*.

And if there be imagined Parallels to the Horizon

rizon upwards towards the Zenith, they are call-
ed *Almicantars*, or Circles of Altitude.

Those that inhabit under the Equinoctial are
said to have a *right Sphere*; those under either
Pole a *Parallel Sphere*; but those in any other
part an *Obliqua Sphere*.

Of the Motions attributed to the Sun.

The Sun seems to have a twofold motion,
the one from East to West, by which he makes
the days and nights, and is, tho seemingly, a
motion in the Sun, only the turning of this
Globe of Earth and Water on its own *Axis* from
West to East in twenty four hours.

The other is of the Sun to West from East,
quite round within the Orb of the Fix'd Stars
from Constellation to Constellation till in about
365¼ days he comes to the same place or Constel-
lation again, and the tract or way he describes a-
mongst the fix'd Stars in this passage, is called
the Ecliptick which is divided into twelve e-
qual parts, called Signs, and are named thus,

♈ *Aries*, ♉ *Taurus*, ♊ *Gemini*, ♋ *Cancer*, ♌
Leo, ♍ *Virgo*, ♎ *Libra*, ♏ *Scorpio*, ♐ *Sagit-
tarius*, ♑ *Capricornus*, ♒ *Aquarius*, ♓ *Pisces*.

This motion also, tho attributed to the Sun is really a motion of the Earth round the Sun making Summer and Winter, Increase and Decrease of Declination, and length of days with differing times and places of Rising and Setting.

The points where the Equinoctial and Ecliptick cut one the other are called the Equinoctial Points.

The distance of the Sun or any Star from the Equinoctial, either North or South, or the Arch of a Meridian between the Sun or Star, and the Equator is called its Declination.

When by the turning of the earth on it's *Axis*, the East Part of the Horizon is brought to the Sun or any Star, the sun or star is said to rise, and when the West Part of the Horizon is brought to the sun or star, it's said to set.

The point or degree of the Equinoctial that comes to the Meridian, together with the sun, or any star being numbred from the Equinoctial Point ♈ is called it's *Right Ascension*.

The degree of the Equinoctial that riseth with the sun or star in an oblique sphere is called its oblique Ascension, and the degree that sets with it the oblique Descension.

The distance of the sun or any stars rising from the East, or setting from the West, that is, the Arch of the Horizon between the Rising Star and the East, or setting star and the West Point is called its *Amplitude*.

The

The Time of the Suns rising or setting before or after six of the clock, is called its *Difference of Ascension*.

The Arch of the Horizon between the Meridian, and an Azimuth Circle passing through the Center of the sun, or any star, is called the *Azimuth*.

Altitude is the Angle between the Horizon and Visual Ray, or Line, passing from the eye to the Center of the sun or star observed.

Of the Moons Motions.

To the Moon also is attributed a twofold motion, the first from East to West in 24 hours, 50 minutes nearly, whereby she seems to rise, culminate and set, being likewise as in the sun and stars only an effect of the Earths dayly motion on its *Axis*: for tho the diurnal motion of the Earth be performed in 24 hours nearest, yet because the moon every day, by her own motion moves Eastward (as after will be shewed) about 13 degrees each day, the Meridian doth not come to her, or she to it, till 13 degrees, or 48 minutes of time after its return to the sun, or 50 minutes of time after its return to the same point of the Heavens.

The other motion is from West to East round about the Earth contrary to the first, whereby she appears in all her phases, and makes all her

Aſpects with the ſun and ſtars, as Horned, Half-ed, Gibbous, New, now applying to this ſtar, then obſcuring that &c. And in this her proper motion ſhe is 27 deg. 8 hours, paſſing from any firſt ſtar or point of the Ecliptick, till ſhe comes to it again. But from one Conjunction with the ſun to another, ſhe ſpends 29 degrees, 12 hours; for tho in 27 deg. 8 hours ſhe return to the ſame point of the Ecliptick, ſhe doth not find the ſun in the point ſhe left him, for the Earth or ſun moving every day about one degree towards the Eaſt, is moved ſo far from the place where the Moon left him, as that ſhe cannot over-take the ſun to come in Conjunction with him, until ſhe has moved 2 deg. 4 hours, 44 m. more, and this is the true cauſe why there's 29 deg. 12 hours, 44 min. between New and New, when as in 27 deg. 8 hours. ſhe compleats her revolution from any fix'd point of the Heaven to the ſame again.

But the moſt People loving round numbers, have for a long time uſed to allow 30 days between one Conjunction and another, which tho it be 11 hours, 16 min. too much; yet for as much as its a cuſtom amongſt them, I ſhall here not reform but explicate.

Now by dividing 360 by 30, its plain that ſhe departs from the ſun each day 12 degrees, or 48 minutes of time, which is $\frac{4}{5}$ of an hour, ſo that ſhe will come to the Meridian $\frac{4}{5}$ of an hour

hour every day later than the day before, and so many days old as she is, so many times $\frac{4}{5}$ of an hour, or $\frac{4}{5}$ of so many hours will she come to the Meridian after the sun.

For want of a fitter Instrument to observe this separation of the Moon from the sun at sea, they have applyed this motion of the Moon to the Compass, making it an Horizontal Motion, dividing the Compass Card into hours and quarters, a division proper only to the Equinoctial, this they use for the estimating time, as also for computing the Tydes, for both which it's very unfit, and no ways to be allowed of, unless near the Pole where the Equinoctial and Horizon do almost coincide.

A Table of the Latitudes and Longitudes of the principal Ports, Harbours, Head-Lands and Islands in the World. Their Longitude being reckoned from the *Lizard*.

Coast of *Greenland* and *Nova Zembla*.

Places Names.	Latitude North.		Long. East.	
	deg	mi.	d.	m.
Harlaits Head-Land	79	31N	17	1[illegible]
Fair Foreland	79	30N	15	4[illegible]
Point look out	77	30N	21	2[illegible]
Hope Island	76	16N	31	4[illegible]
Cherry Island	75	20N	30	3[illegible]
Ice Point	77	10N	71	3[illegible]
Cape Nassaw	76	30N	72	0[illegible]
Admiralties Island	75	10N	68	3[illegible]
Barrough's Strait	66	30N	68	3[illegible]

Coast

Coast of *Lapland* and *Norway*.

Places Names.	Latitud. North		Long. East.	
	deg.	m.	d.	m.
Cape Candenos	68	40N	48	10
Bergen	61	00N	11	10
Archangel	65	30	45	10
North	70	50	23	10
Kildivin Ile	69	50	35	00
North Cape	71	38	27	30
Naze of Norway.	58	11	11	30

Coasts

Coasts in the *Sound.*

Places Names.	Latit. North.		Longit. East	
	d.	m.	deg.	mi.
Dantzick	54	23	24	38
Stetia.	53	16	20	00
Stockholm	59	20	23	44
Gotland Isa.	58	10	22	45
Elsenare	56	40	17	47
Copen-Haven	55	43	17	45
Gottenberg	58	10	15	17
The Scaw	57	37	5	30
Coningsberg	55	28	26	00

Islands

Iſlands about the Coaſts of *Scotland.*

Places Names.	Latit. North	Longit. Eaſt.
	d. m.	deg. mi.
Shetland	60 22	03 30
Iſles of Orkney	58 50	02 20
Fair Iſlands	61 43	00 10W
Lewis Iſland	58 30	01 30W
Kilda Iſland	58 02	02 10W
Beſs Iſland	59 10	12 40W

Coaſt of *Iſland.*

Places Names.	Latit. North	Longit. Eaſt.
	d. m	d. m.
Longneſs	58 04	08 50W
Merchants Foreland	63 36	12 50W

Coaſts

Coasts of *Holland* and *Flanders.*

Places Names.	Latit. North		Longit. East.	
	d.	m	d.	m.
Hamburg	53	44	14	20
The Texel	53	03	11	00
Amsterdam	52	22	10	58
Roterdam	51	55	10	30
The Brill	51	55	10	08
Ostend	51	17	9	18
Dunkirk	51	07	8	55
Calice	51	00	0	00
Antwerp	51	12	10	30

Coast

Places Names.	Latit. North		Longit.	
	d.	m	l.	m.
Barbarels	58	04	3	45
Tinmouth	55	12	1	10
Flamborough Head	54	10	0	8
The Spurn	53	41	0	20
Lyndon	53	30	0	00
Distenton ait's	52	54	0	45
Orfordneſs	52	24	0	47
North Foreland	51	36	0	35
South-Foreland	51	13	0	30
Dover	51	12	0	29
Dungeneſs	50	00	0	08
The Beach	50	43	0	46
East-Portland of the wight	50	32	0	56
Donoſe	50	26	0	36
The Needles	50	33	0	15
Portland	50	28	0	25
Tot Start	50	8	0	53
The Lizard	50	0	0	00
The Southermoſt of all the Iſles and Rocks of Silly	49	9	1	10W
Londys Iſle	51	28	1	20
Dauid's Head	52	0	0	35 E.
Briſtol	51	18	2	30
The South Point of S. Maries, or of the Silly Iſles	49	57	0	52W
The middle of Argle, or S. Agnes one of the Iſles of Silly, on which is the Light-houſe.	49	55	1	01W
Liverpool	53	29	2	32 E.

In the Iriſh Seas.

Places Names.	Latit. North.		Longit. East.	
	d.	m.	d.	m.
Holy Head.	53	33	1	36
The Calf of Man	54	10	1	20
The moſt Northerly Point of the Iſle of Man, called Point Ayre.	54	34	1	40
Fair-Head, or Fair-Foreland	55	15	0	35W
Blaſques	52	03	3	35W
Miſſen-Head	51	19	3	45W
Cape Clear	51	02	3	00W
Old Head	51	28	2	30W
Black Rock	52	08	0	35W
Dublin	53	22	0	30W

Weſtern

Weſtern Coaſts of *France*, *Spain* and *Portugal*.

Places Names.	Latit. North.		Longit. Eaſt.	
	d.	m.	d.	m.
Scyn Head	49	50	6	20
Cape Hoge	49	11	3	35
Garnſey	49	31	3	05
Jerſey	49	30	3	30
Mhant	48	35	0	00
S. Malos	48	28		
Breſt	48	30	0	10
Bourdeaux	45	30	4	30
Bilboa	43	34	2	40
Cape Ortegal	44	04	2	00W
Cape Finiſterre	43	06		
Lisbon	38	48	3	30W
Cape Vincent	37	00	3	45W

Sea

Sea Coasts on the North-Side of the *Mediterranean* from the *Straits*-Mouth to the Head thereof.

Places Names	Latit. North.		Longit. East.	
	d.	m.	d.	m.
Cape de Gata	36	35	2	47
Cape Martin	38	34	5	27
* *Marſeilles*	43	20	11	30
Genoa	44	27	15	50
* *Rome, the City*	41	45	21	00
Cape Spartaventura	37	34	25	00
Cape Maria	39	40	27	00
* *Naples*	41	03	12	42
Livornia, or Legorn	43	18	17	45
* *Venice*	45	20	19	48
Cape Matapan	36	00	31	40
* *Salamanca*	41	12	11	45
* *Aleppo*	36	06	41	15
* *Alexandria*	30	58	27	00
Antiochia	35	15	33	15
Alberca	37	42	33	07
* *Barcellona*	41	26	3	00
* *Grand Cair*	29	50	38	15

Places

Places in the *Mediterranean* on the North Side.

Places Names.	Latit. North		Longit. East.	
	d.	m.	d.	m.
* *Florence*	43	40	16	00
* *Parma*	44	51	17	30
* *Piſa*	43	28	18	00
Tunis	35	18	17	37
Cape Tres Forcas	35	28	2	07
Tangier	35	25	0	54 E

Iſlands

Iſlands in the *Straits*;

Places Names.	Latit. North		Longit. Eaſt.	
	d.	mo	d.	m.
* *Palermo, on the Iſle Sicily.*	38	1	21	10
* *Porton Majorca*	39	35	9	15
* *Rhodes.*	36	0	35	50
Minorca	39	56	10	50
Cape Napoli in Sardinia.	39	10	15	31
Malta	35	45	22	40
Meſſina	37	20	20	55
Curſu	38	54	17	50
Cephalonia	37	57	28	30
Zant	36	42	28	40
Cape Spudza in Candia.	34	50	32	05
Candia City.	34	40	31	50
Weſt End of Cyprus	33	27	39	10
Eaſt End of Cyprus	33	53	42	35

The Difference of Longitude between the *Lizard* and *London* is between 5 deg. 37 min. and 5 deg. 44 min.

Breſt is from *Paris* 7 deg. and from *London* 30 deg. 40 min. and from the *Lizard*, allowing the diſtance of the *Lizard* from *London* to be 5 deg. 40 min. juſt 1 deg. 00 min, but if we make the diſtance between *London* and the *Lizard* to be 6 deg. then the difference is 1 deg. 20 min.

Ferraria is more Eaſterly than *Bononia* by 15 min. 4 ſec. And *Ravenna* is more Eaſterly than *Bononia* by 42 deg. 26 ſec. *Mantua* is more Weſterly than *Bononia* by 23 deg. 27 ſec.

The true difference of Longitude between *Palma* and the *Lizard* is 12 deg. 5 min.

THE New World of Words. Or a General English Dictionary, Containing the Proper Significations and Etymologies of all Words derived from other Languages, *viz. Hebrew, Arabick, Syriack, Greek, Latin, Italian, French, Spanish, British, Dutch, Saxon*, &c. useful for the Adornment of our English Tongue. Together with the Definitions of all those Terms that conduce to the understanding of any of the Arts or Sciences, *viz.* Theology, Philosophy, Logick, Rhetorick, Grammar, Ethicks, Law, Magick, Physick, Chyrurgery, Anatomy, Chymistry, Botanicks, Arithmetick, Geometry, Astronomy, Astrology, Chyromancy, Physiognomy, Navigation, Fortification, Dialling, Surveying, Musick, Perspective, Architecture, Heraldry, Staticks, Merchandise, Jewelling, Painting, Graving, Husbandry, Horsemanship, Hawking, Hunting, Fishing, Carving, &c. To which are added, The Significations of Proper Names, derived from the Ancient or Modern Tongues; as also the very sum of all Mythology and Ancient History, deduced from the Names of Persons eminent in either; and likewise the Geographical Descriptions of the chief Countries and Cities in the World; especially of these three Nations, wherein their chiefest Antiquities, Batels, and other most memorable Passages are mentioned: not omitting all other Subjects that are useful, and appertain to Advance our *English* Language. The Fourth Edition.

Sold by *Obadiah Blagrave* at the *Bear* in S. *Paul's* Church-Yard, near the Little North-door.

Here followeth

A Traverſe TABLE

To Find the

Difference of Longitude and Diſtance.

Which muſt be placed after the Table of Artificial Sines and Tangents: after the Signature H.

A Traverſe Table to be entred with the

Dif. of Lat.	¼ Poi.		½ Poi.		¾ Poi.		1 Poi.		1¼ Poi		1½ Poi.		1¾ Poi.		2 Poi.	
	M		M	P	M	P	M	P	M		M	P	M	P	M	P
1																
2																
3																
4																
5																
6																
7																
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24																
25																
30																
40																
50																

2 1/4 Poi.		2 1/2 Poi.		2 3/4 Poi.		3 Poi.		3 1/4 Poi.		3 1/2 Poi.		3 3/4 Poi.		4 Poi.		Dift. of Lat.
M	P	M	P	M	P	M	P	M	P	M	P	M	P	M	P	M
	5		5		6	0	7		7		8		9	0	0	1
	9	1	1	1	2	1	3	1	3	1	4	1	5	2	0	2
1	4	1	6	1	8	2	0	2	2	2	3	2	7	3	0	3
1	9	2	1	2	4	2	7	3	0	3	3	3	8	4	0	4
2	4	2	7	3	0	3	3	3	7	4	1	4	5	5	0	5
2	8	3	2	3	6	4	0	4	5	4	9	5	3	6	0	6
3	3	3	7	4	2	4	7	5	2	5	7	6	2	7	0	7
3	8	4	2	4	8	5	3	5	9	6	6	7	2	8	0	8
4	2	4	8	5	4	6	0	6	7	7	4	8	2	9	0	9
4	7	5	2	6	0	6	7	7	4	8	2	9	1	10	0	10
5	2	5	9	6	6	7	3	8	2	9	0	10	0	11	0	11
5	7	6	4	7	2	8	0	8	9	9	8	10	5	12	0	12
6	1	6	9	7	8	8	7	9	6	10	7	11	8	13	0	13
6	6	7	5	8	4	9	1	10	4	11	5	12	7	14	0	14
7	1	8	0	9	0	10	0	11	1	12	3	13	6	15	0	15
7	6	8	6	9	6	10	7	11	9	13	1	14	5	16	0	16
8	0	9	1	10	2	11	3	12	6	14	0	15	4	17	0	17
8	5	9	6	10	8	12	0	13	4	14	8	16	3	18	0	18
9	0	10	2	11	4	12	7	14	1	15	6	17	2	19	0	19
9	5	10	7	12	0	13	4	14	8	16	4	18	1	20	0	20
9	9	11	1	12	6	14	0	15	6	17	2	19	0	21	0	21
10	4	11	5	13	2	14	7	16	3	18	1	19	8	22	0	22
10	9	12	3	13	8	15	3	17	1	18	9	20	8	23	0	23
11	3	12	8	14	4	16	0	17	8	19	7	21	7	24	0	24
11	8	13	4	15	0	16	7	18	5	20	5	22	7	25	0	25
14	2	16	0	18	0	20	0	22	1	24	0	27	2	30	0	30
18	9	21	4	24	0	26	7	29	7	32	8	36	3	40	0	40
23	7	26	7	29	0	33	4	37	1	41	0	45	3	50	0	50

A Traverse Table to be entred with the

Dist. of the M.	3½ Poi.		4 Poi.		4½ Poi.		5 Poi.		5¼ Poi.		5½ Poi.		5¾ Poi.		6 Poi.	
	M	P	M	P	M	P	M	P	M	P	M	P	M	P	M	P
1	1	1	1	2	1	3	1	5	1	7	1	9	2	1	2	4
2	2	2	2	4	2	7	3	0	3	3	3	7	4	3	4	8
3	3	3	3	7	4	0	4	5	5	0	5	6	6	4	7	1
4	4	4	5	5	5	4	6	0	6	7	7	5	8	5	9	5
5	5	6	6	8	7	7	7	5	8	1	9	4	10	6	12	0
6	6	7	8	1	9	0	10	0	11	2	12	2	12	7	14	4
7	7	8	9	4	10	5	11	7	13	1	14	4	14	8	16	9
8	8	9	10	8	12	0	13	3	15	0	16	3	16	9	19	1
9	9	11	12	1	13	5	15	0	16	8	18	1	18	10	21	6
10	11	12	13	5	15	0	16	7	18	7	20	1	20	11	24	1
11	12	13	14	8	16	5	18	4	20	6	22	1	22	13	26	5
12	13	14	16	1	17	8	20	0	22	4	24	0	24	14	28	10
13	14	15	17	5	19	3	21	7	24	3	25	7	26	15	31	2
14	15	17	18	9	20	6	23	4	26	2	27	6	28	16	33	6
15	16	18	20	2	22	1	25	0	28	1	29	7	30	17	35	11
16	17	19	21	6	23	4	26	7	29	5	31	8	32	18	37	7
17	18	20	22	9	24	7	28	4	31	4	33	8	34	19	39	11
18	19	21	24	1	26	1	30	0	33	7	35	9	36	20	41	3
19	20	23	25	5	27	4	31	7	35	5	37	9	38	21	43	7
20	22	24	26	8	28	7	33	4	37	4	39	10	40	22	45	12
21	23	25	28	1	30	1	35	0	39	3	41	11	42	23	47	8
22	24	26	29	5	31	4	36	7	41	1	43	12	44	24	49	12
23	25	28	30	8	33	1	38	4	43	0	45	13	46	25	51	13
24	26	29	32	1	34	4	40	0	44	6	47	14	48	26	53	14
25	27	30	33	5	35	7	41	7	46	8	49	15	50	27	55	15
30	33	36	40	2	43	1	50	0	56	1	59	3	60	33	67	2
40	44	48	53	9	57	9	66	7	74	8	79	4	80	44	89	3
50	55	60	67	4	72	4	83	4	93	5	99	5	101	55	111	4

6/4 Pol.		6/8 Pol.		6/12 Pol.		7 Pol.		7/4 Pol.		7/8 Pol.		7/12 Pol.		Diff. of Lat.
M	P	M	P	M	P	M	P	M	P	M	P	M	P	M
2	8	3	3	4	1	5	0	6	7	7	6	10	4	1
5	6	6	6	8	0	10	0	13	5	15	3	20	7	2
8	4	9	9	12	0	15	1	20	2	23	5	31	1	3
11	2	13	2	16	0	20	1	27	0	43	6	41	4	4
14	0	16	5	20	0	25	1	33	7	50	8	102	8	5
16	9	19	8	24	0	30	1	40	5	62	9	113	6	6
19	6	22	1	28	0	35	2	47	3	73	1	133	4	7
22	4	25	4	32	0	40	2	53	2	83	2	153	2	8
25	2	28	7	36	0	45	2	60	1	93	4	173	1	9
27	9	31	0	39	0	50	3	67	0	104	5	193	0	10
30	7	34	3	43	0	55	3	73	8	114	7	213	0	11
33	5	37	6	47	0	60	4	80	6	125	8	233	0	12
36	3	41	0	51	0	65	4	87	5	136	9	253	0	13
39	1	44	3	55	0	70	4	94	4	148	0	273	0	14
41	9	47	6	59	0	75	4	101	3	159	1	293	0	15
44	7	50	7	63	0	80	4	107	9	170	4	313	7	16
47	5	53	0	67	0	85	5	114	8	177	6	346	0	17
50	3	57	3	71	0	90	5	121	3	188	7	366	4	18
53	1	60	5	75	0	95	5	128	1	199	9	386	7	19
55	9	63	9	79	0	100	6	134	6	209	1	407	0	20
58	7	69	2	83	0	105	6	141	6	219	3	427	5	21
61	5	72	5	87	0	110	6	148	1	229	4	447	8	22
64	3	75	8	91	0	115	6	155	0	239	5	468	2	23
67	1	79	1	95	0	120	6	161	8	249	7	488	5	24
69	9	82	4	99	0	125	7	168	5	259	8	508	8	25
83	8	98	9	119	8	150	5	202	2	304	6	610	7	30
111	8	131	9	159	7	200	1	269	7	406	1	814	2	40
139	9	164	8	199	6	251	4	337	1	507	7	1017	8	50

A Traverse Table to find the

Lat.	1 Rumb.		2 Rumb.		3 Rumb.		4 Rumb.		5 Rumb.	
	11 15		22 30		33 45		45 00		56 15	
D. M.	Long	Dif.	Long	Dif.	Long.	Dif.	Long	Dif.	Long.	Dif.
0 10	2	10	4	11	7	11	10	14	13	17
20	4	21	8	21	15	23	20	28	26	34
30	6	31	11	32	22	34	30	42	39	51
40	8	41	15	43	29	45	40	57	53	68
50	10	52	20	54	37	57	50	71	66	85
1 0	12	62	24	64	44	68	1 0	85	1 19	102
10	14	72	28	75	52	79	1 10	99	1 32	119
20	16	83	33	86	59	91	1 20	113	1 46	136
30	18	93	37	96	1 7	102	1 30	127	2 0	153
40	20	103	41	107	1 14	113	1 40	141	2 13	170
50	22	113	45	118	1 22	125	1 50	156	2 28	187
2 0	24	122	49	128	1 29	136	2 0	170	2 43	204
10	26	133	53	139	1 37	147	2 10	184	2 58	221
20	28	143	57	150	1 44	158	2 20	198	3 13	238
30	30	153	1 2	160	1 52	170	2 30	212	3 28	255
40	32	163	1 6	171	1 59	181	2 40	226	3 43	272
50	34	173	1 10	182	2 7	192	2 50	240	3 58	289
3 0	36	184	1 15	192	2 14	204	3 0	255	4 13	306
10	38	194	1 19	203	2 22	215	3 10	269	4 28	323
20	40	204	1 23	214	2 29	226	3 20	283	4 43	340
30	42	214	1 27	225	2 37	237	3 30	297	4 58	357
40	44	224	1 31	235	2 44	249	3 40	311	5 13	374
50	46	234	1 36	246	2 52	260	3 50	325	5 28	391
4 0	48	245	1 40	256	2 59	271	4 0	339	5 43	408
10	50	255	1 44	267	3 7	282	4 10	354	5 58	425
20	52	265	1 48	278	3 14	294	4 20	368	6 13	442
30	54	275	1 52	288	3 22	305	4 30	382	6 28	459
40	56	285	1 56	299	3 29	316	4 40	396	6 43	476
50	58	295	2 00	310	3 37	327	4 50	410	6 58	493

Difference of Longitude, and Distance.

Lat.	1 Rumb. 11 15		2 Rumb. 22 30		3 Rumb. 33 45		4 Rumb. 45 00		5 Rumb. 56 15	
D. M	Long.	dif.	Long.	dif.	Long.	dif.	Long.	dif.	Long.	dif.
1 0	1 0	1 06	2 4	1 25	3 20	1 41	5 0	1 44	7 30	1 40
20	1 2	1 16	2 8	1 36	3 27	1 53	5 10	1 47	7 45	1 58
40	1 4	1 26	2 13	1 46	3 34	1 58	5 20	1 51	8 0	1 76
30	1 6	1 36	2 17	1 57	3 40	2 17	5 30	2 07	8 15	1 94
40	1 8	1 47	2 20	2 08	3 47	2 29	5 40	2 18	8 30	2 11
50	1 10	1 57	2 24	2 17	3 54	2 41	5 50	2 29	8 45	2 29
2 0	1 12	2 07	2 28	2 30	4 1	2 53	6 0	2 50	9 0	2 40
10	1 14	2 17	2 32	2 40	4 7	2 65	6 10	2 53	9 15	2 66
20	1 16	2 27	2 37	2 51	4 14	2 77	6 20	2 57	9 30	2 84
30	1 18	2 37	2 41	2 62	4 21	2 89	6 30	3 13	9 45	3 02
40	1 20	2 48	2 45	2 73	4 27	3 01	6 40	3 30	10 0	3 20
50	1 22	2 58	2 50	2 84	4 34	3 13	6 50	3 50	10 15	3 38
3 0	1 24	3 08	2 54	3 00	4 41	3 25	7 0	3 54	10 30	3 56
10	1 26	3 18	2 58	3 13	4 47	3 37	7 10	4 08	10 45	3 75
20	1 28	3 29	3 2	3 25	4 54	3 49	7 20	4 22	11 0	3 92
30	1 30	3 39	3 6	3 37	5 1	3 61	7 30	4 36	11 16	4 10
40	1 32	3 49	3 11	3 49	5 8	3 73	7 40	4 51	11 22	4 28
50	1 34	3 59	3 15	4 00	5 14	3 85	7 50	5 06	11 46	4 46
4 0	1 36	4 10	3 19	4 10	5 21	3 97	8 0	5 19	12 1	4 64
10	1 38	4 20	3 24	4 30	5 28	4 09	8 10	5 33	12 16	4 82
20	1 40	4 30	3 28	4 41	5 34	4 21	8 20	5 47	12 31	5 00
30	1 42	4 40	3 32	4 52	5 41	4 33	8 30	6 01	12 47	5 18
40	1 44	4 50	3 36	4 62	5 48	4 45	8 40	6 15	13 2	5 36
50	1 46	5 00	3 40	4 74	5 55	4 57	8 50	6 29	13 17	5 55

A Traverse Table to find the

6 Rumb.		7 Rumb.		Lat.	1 Rumb.		2 Rumb.	
67	30	78	45		11	15	22	30
L. m.	Dif.	L. m.	Dif.	L. M.	Long.	Dif.	Long.	Dif.
	26		38	0	0	0	0	0
	52		77	10	1	10	1	10
1	78	1	115	20	1	21	1	20
1	105	1	153	30	1	31	1	30
2	131	2	192	40	1	41	1	40
				50	1	52	1	50
2	157	3	230	1 0	1	62	1	60
3	183	3	268	10	2	73	2	70
3	209	4	307	20	2	83	2	80
3	236	4	345	30	2	94	2	90
4	262	5	383	40	2	104	2	100
4	288	5	422	50	2	115	2	110
4	314	6	460	2 0	2	125	2	120
5	340	6	498	10	2	135	2	130
5	366	6	537	20	2	146	2	140
6	392	7	575	30	2	156	2	150
6	418	7	614	40	2	167	2	160
6	444	8	652	50	2	177	2	170
7	470	8	690	3 0	2	188	2	180
7	496	8	729	10	2	198	2	190
8	523	9	767	20	2	208	2	200
8	549	9	805	30	2	219	2	210
8	575	10	844	40	2	229	2	220
9	601	10	882	50	2	240	2	230
9	627	10	920	4 0	2	250	2	240
9	653	11	959	10	2	260	2	250
10	679	11	997	20	2	271	2	260
10	706	12	1035	30	2	281	2	270
11	732	12	1074	40	2	292	2	280
11	758	13	1112	50	2	302	2	290
				5 0	2	313	2	300
				10	2	323	2	310
				20	2	333	2	320
				30	2	344	2	330
				40	2	354	2	340
				50	2	365	2	350
				6 0	2	375	2	360
				10	2	385	2	370
				20	2	396	2	380
				30	2	406	2	390
				40	2	417	2	400
				50	2	427	2	410
				7 0	2	437	2	420
				10	2	448	2	430
				20	2	458	2	440
				30	2	469	2	450
				40	2	479	2	460
				50	2	490	2	470
				8 0	2	500	2	480
				10	2	510	2	490
				20	2	521	2	500
				30	2	531	2	510
				40	2	542	2	520
				50	2	552	2	530
				9 0	2	562	2	540
				10	2	573	2	550
				20	2	583	2	560
				30	2	594	2	570
				40	2	604	2	580
				50	2	615	2	590
				10 0	2	625	2	600
				10	2	635	2	610
				20	2	646	2	620
				30	2	656	2	630
				40	2	667	2	640
				50	2	677	2	650
				11 0	2	687	2	660
				10	2	698	2	670
				20	2	708	2	680
				30	2	719	2	690
				40	2	729	2	700
				50	2	740	2	710
				12 0	2	750	2	720
				10	2	760	2	730
				20	2	771	2	740
				30	2	781	2	750
				40	2	792	2	760
				50	2	802	2	770
				13 0	2	813	2	780
				10	2	823	2	790
				20	2	833	2	800
				30	2	844	2	810
				40	2	854	2	820
				50	2	865	2	830

6 Rumb. 67		7 Rumb. 78		45	Lat.	1 Rumb. 11		2 Rumb. 22		30
Long.	dist.	Long.	dist.		D. M.	Long.	dist.	Long.	dist.	
22 05	1824	25	1538		14 0	2 49	8166	5 51	9179	
22 29	1850	26	1559		10	2 51	8207	5 55	9220	
22 54	1876	26	1623		20	2 53	8274	6 00	9311	
23 17	1862	27	1641		30	2 55	8276	6 4	9262	
23 41	1858	28	1743		40	2 57	8276	6 8	9312	
24 06	1915	29	1796		50	2 59	8276	6 13	9263	
24 30	1961	30	1845		15 0	3 1	9486	17	9274	
24 55	1969	31	1857		10	3 3	9286	20	9285	
25 19	1993	31	1948		20	3 6	9396	28	9306	
25 44	1918	32	1992		30	3 8	9426	29	1027	
26 8	2045	33	2030		40	3 10	9536	34	1027	
26 33	2071	34	2102		50	3 12	9596	39	1018	
26 57	2098	35	2138		20 0	3 14	9706	45	1039	
27 21	2124	36	2206		10	3 16	9826	47	10.0	
27 45	2150	37	2254		20	3 18	9936	51	1061	
28 10	2176	38	2827		30	3 20	1.096	57	1072	
28 34	2202	38	2358		40	3 22	1.016	59	1082	
28 58	2228	39	2409		50	3 24	1.026	64	1093	
29 22	2254	40	2460		25 0	3 26	1.046	9	1104	
29 47	2280	40	2512		10	3 28	1.056	11	1115	
30 11	2306	42	2564		20	3 30	1.076	19	1126	
30 35	2332	42	2614		30	3 32	1.086	21	1136	
31 00	2358	43	2665		40	3 34	1.096	26	1147	
31 24	2384	44	2717		50	3 36	1.106	32	1158	

A Traverse Table to find the

Lat.	3 Rumb. 11		4 Rumb. 45		5 Rumb. 56		6 Rumb. 67		7 Rumb. 78	
D. M	Long.	dist.	ong.	dist.	Long.	dist.	ong.	dist.	Long.	
0 0	0	0	0	0	0	0	0	0	0	
10	0	10	0	10	0	10	0	10	0	
20	0	20	0	20	0	20	0	20	0	
30	0	30	0	30	0	30	0	30	0	
40	0	40	0	40	0	40	0	40	0	
50	0	50	0	50	0	50	0	50	0	
1 0	0	1 0	0	1 0	0	1 0	0	1 0	0	
10	0	10	0	10	0	10	0	10	0	
20	0	20	0	20	0	20	0	20	0	
30	0	30	0	30	0	30	0	30	0	
40	0	40	0	40	0	40	0	40	0	
50	0	50	0	50	0	50	0	50	0	
2 0	0	2 0	0	2 0	0	2 0	0	2 0	0	
10	0	10	0	10	0	10	0	10	0	
20	0	20	0	20	0	20	0	20	0	
30	0	30	0	30	0	30	0	30	0	
40	0	40	0	40	0	40	0	40	0	
50	0	50	0	50	0	50	0	50	0	
3 0	0	3 0	0	3 0	0	3 0	0	3 0	0	
10	0	10	0	10	0	10	0	10	0	
20	0	20	0	20	0	20	0	20	0	
30	0	30	0	30	0	30	0	30	0	
40	0	40	0	40	0	40	0	40	0	
50	0	50	0	50	0	50	0	50	0	

Difference of Longitude, and Distance.

Deg.	3 Rumb. 11 15		4 Rumb. 45		5 Rumb. 56 15		6 Rumb. 67		7 Rumb.	
M	Long.	Dist.	Long.	Dist.	Long.	Dist.	Long.	Dist.	Long.	Dist.
0	9 28	10	14 8	1188	21 10	1513	34 10	2193	78 0	4300
10	9 34	1022	14 18	1202	21 32	1530	34 34	2221	78 37	4357
20	9 41	1034	14 28	1216	21 40	1546	34 58	2247	79 49	4409
30	9 47	1046	14 38	1230	21 58	1562	35 22	2273	80 40	4456
40	9 54	1058	14 48	1244	22 18	1582	35 46	2300	81 36	4511
50	10 0	1070	14 58	1259	22 26	1598	36 10	2326	82 32	4562
1 0	10 8	1082	15 10	1272	22 42	1620	36 38	2357	83 16	4614
10	10 15	1094	15 22	1286	22 58	1638	37 02	2378	83 58	4661
20	10 22	1106	15 32	1300	23 14	1656	37 28	2400	84 52	4711
30	10 30	1118	15 42	1315	23 32	1674	37 52	2430	85 44	4763
40	10 37	1130	15 52	1329	23 44	1692	38 18	2452	86 47	4818
50	10 44	1141	16 2	1343	24 04	1710	38 42	2482	87 38	4870
2 0	10 50	1153	16 12	1358	24 16	1728	39 8	2500	88 24	4922
10	10 56	1165	16 23	1372	24 32	1746	39 32	2524	89 28	4987
20	11 3	1178	16 33	1386	24 47	1766	39 52	2550	90 16	5032
30	11 10	1190	16 44	1400	25 2	1782	40 22	2587	91 0	5097
40	11 17	1202	16 53	1414	25 18	1800	40 50	2612	91 58	5152
50	11 24	1215	17 5	1428	25 28	1818	41 12	2639	92 55	5217
3 0	11 31	1227	17 15	1442	25 46	1836	41 40	2665	93 44	5280
10	11 39	1239	17 25	1457	26 0	1854	42 5	2691	94 42	5280
20	11 46	1251	17 35	1471	26 20	1872	42 30	2718	95 32	5331
30	11 53	1263	17 47	1485	26 36	1890	42 56	2744	96 25	5381
40	12 00	1275	17 57	1499	26 52	1908	43 22	2770	97 18	5433
50	12 07	1287	18 8	1513	27 8	1926	43 46	2796	98 7	5485

A Traverse Table to find the

Lat.	1 Rumb. 11 15		2 Rumb. 22 30		3 Rumb. 33 45		4 Rumb. 45 00	
D. M.	Long.	dist.	Long.	dist.	Long.	dist.	Long.	dist.
16 0	3 31	1101	7 34	1107	12 14	1190	18 19	1517
10	3 40	1111	7 47	1120	12 21	1218	18 29	1540
20	3 42	1122	7 44	1191	12 28	1223	18 39	1559
30	3 44	1132	7 48	1201	12 35	1235	18 49	1579
40	3 46	1142	7 52	1212	12 42	1247	19 0	1594
50	3 49	1152	7 5	1223	12 49	1259	19 10	1598
17 0	3 51	1162	8 1	1234	12 56	1271	19 21	1602
10	3 5.	1173	8 5	1245	13 03	1283	19 31	1626
20	3 55	1183	8 10	1256	13 10	1295	19 42	1640
30	3 57	1193	8 14	1268	13 18	1307	19 53	1655
40	3 59	1203	8 19	1277	13 25	1319	20 4	1669
50	4 0.	1213	8 24	1288	13 32	1331	20 14	1683
30 0	4 4	1224	8 28	1299	13 39	1343	20 25	1697
10	4 7	1234	8 32	1310	13 46	1355	20 35	1711
20	4 9	1244	8 36	1321	13 53	1367	20 46	1725
30	4 11	1254	8 41	1332	14 0	1379	20 57	1739
40	4 13	1264	8 45	1342	14 8	1390	21 7	1754
50	4 15	1274	8 49	1354	14 15	1402	21 17	1768
21 0	4 17	1283	8 54	1364	14 22	1415	21 28	1782
10	4 15	1293	8 59	1375	14 29	1427	21 39	1796
20	4 21	1303	9 2	1385	14 36	1439	21 50	1811
30	4 2.	1313	9 7	1396	14 44	1451	22 1	1825
40	4 25	1323	9 12	1407	14 51	1463	22 12	1839
50	4 27	1336	9 16	1418	14 58	1475	22 22	1854
22 0	4 29	1346	9 20	1429	15 5	1488	22 33	1867
10	4 31	1356	9 25	1440	15 12	1500	22 44	1881
20	4 2.	1366	9 30	1451	15 19	1512	22 55	1895
30	4 35	1376	9 34	1462	15 26	1524	23 6	1909
40	4 37	1387	9 38	1472	15 33	1536	23 17	1923
50	4 40	1397	9 43	1483	15 41	1548	23 28	1937

Difference of Longitude and Distance.

Lat.	1 Rumb. 11 15		2 Rumb. 22 30		3 Rumb. 33 45		5 Rumb. 45 00	
D.M	Long.	dist.	Long.	dist.	Long.	dist.	Long.	dist.
23 0	4 42	1407	9 42	1494	15 46	1650	23 39	1912
10	4 44	1417	9 52	1525	15 55	1672	23 46	1936
20	4 46	1427	9 57	1551	16 3	1684	24 00	1980
30	4 48	1438	10 2	1530	16 12	1696	24 12	1973
40	4 50	1448	10 7	1517	16 17	1708	24 22	2008
50	4 52	1458	10 11	1548	16 24	1720	24 33	2012
24 0	4 55	1468	10 15	1519	16 31	1732	24 46	2036
10	4 57	1478	10 19	1570	16 39	1744	24 55	2041
20	4 59	1489	10 24	1582	16 46	1756	25 6	2035
30	5 2	1499	10 29	1591	16 55	1768	25 17	2079
40	5 4	1509	10 33	1602	17 1	1781	25 28	2083
50	5 6	1519	10 37	1613	17 8	1792	25 32	2097
25 0	5 8	1530	10 42	1624	17 16	1804	25 50	2121
10	5 10	1540	10 46	1634	17 21	1816	26 1	2133
20	5 12	1550	10 51	1645	17 30	1828	26 12	2150
30	5 14	1560	10 56	1656	17 38	1840	26 21	2164
40	5 16	1572	11 1	1667	17 45	1852	26 30	2178
50	5 18	1582	11 5	1678	17 52	1864	26 45	2192
26 0	5 21	1591	11 9	1688	18 0	1876	26 56	2206
10	5 23	1601	11 14	1699	18 7	1888	27 7	2220
20	5 24	1611	11 19	1710	18 15	1900	27 18	2234
30	5 28	1621	11 23	1721	18 22	1912	27 29	249
40	5 30	1631	11 28	1732	18 30	1924	27 47	2263
50	5 32	1642	11 32	1743	18 37	1936	27 51	2277

A Traverse Table to find the

Lat.	5 Rumb. 56 15			6 Rumb. 67 30			7 Rumb. 78 45			Lat.	1 Rumb.		
D. M.	Long.		dist.	Long.		dist.	Long		dist.	D. M.	Long.		dist.
26 0	27	24	1/46	44	11	2822	92	01	5536	17 0	5	34	
10	27	32	1262	44	37	2848	92	55	5587	10	5	3	
20	27	55	1923	44	2	2870	93	44	5638	20	5	32	
30	28	11	1993	45	27	2621	94	40	5690	30	5	4	
40	28	27	2016	35	55	2927	95	32	5741	40	5	42	
50	28	42	2034	46	18	2953	95	5	5791	50	5	4	
27 0	28	58	2052	46	45	2979	97	29	5843	18 0	5	4	
10	29	14	2072	47	11	3005	98	14	5895	10	5	50	
20	29	29	2088	47	36	3031	99	04	5946	20	5	52	
30	29	46	2106	48	2	3057	99	58	6047	30	5	55	
40	30	32	2124	48	27	3083	100	51	6048	40	5	57	
50	30	18	2142	48	51	3110	101	46	6100	50	6	00	
28 0	30	34	2160	49	18	3136	102	40	6151	19 0	6	02	
10	30	50	2178	49	44	3162	103	30	6202	10	6	04	
20	31	6	2180	50	09	3188	104	25	6254	20	6	07	
30	31	21	2214	50	35	2186	105	19	6305	30	6	09	
40	31	37	2232	51	01	3230	106	14	6356	40	6	11	
50	31	53	2250	51	26	3266	107	08	6407	50	6	14	
29 0	32	9	2268	51	52	3292	108	3	6458	20 0	6	16	
10	32	25	2286	52	20	3319	108	57	6510	10	6	18	
20	32	42	2034	52	43	3345	109	48	6561	20	6	21	
30	32	57	2322	53	11	3371	110	43	6612	30	6	23	
40	33	14	2340	53	37	3397	111	38	6664	40	6	25	
50	33	30	2358	54	03	4423	112	32	6715	50	6	27	
23 0	33	46	2376	54	29	3449	113	25	6746	21 0	6	29	
10	34	2	2394	54	55	3475	114	20	6797	10	6	31	
20	34	18	2412	55	21	3502	115	13	6849	20	6	34	
30	34	34	2430	55	47	3528	116	09	6900	30	6	36	
40	34	51	2448	56	12	3554	117	04	6951	40	6	39	
50	35	07	2466	56	38	3580	117	59	7003	50	6	41	

Difference of Longitude, and Distance.

Lat.	5 Rumb. 10 15		6 Rumb. 67 30		7 Rumb. 78 45		Lat.	1 Rumb.	
D. M	Long.	Dist.	Long.	Dist.	Long.	Dist.	D. M	Long.	Dist.
0	15 13	1484	57 05	1504	118 56	7073	32 0	6 4	1958
10	15 40	1502	57 31	1631	119 45	7126	10	6 40	1984
20	15 56	1520	57 57	1658	120 41	7177	20	6 48	1978
30	16 12	1538	58 23	1614	121 37	7228	30	6 50	1988
40	16 28	1556	58 51	1711	122 32	7280	40	6 52	1998
50	16 45	1574	59 18	1736	123 24	7318	50	6 53	2009
0	17 1	1592	59 44	1705	124 24	7384	33 0	6 57	2019
10	17 17	1610	60 11	1732	125 15	7432	10	7 00	2029
20	17 34	1628	60 37	1815	126 11	7484	20	7 03	2039
30	17 50	1646	61 03	1841	127 7	7535	30	7 05	2049
40	18 7	1664	61 32	1867	128 0	7586	40	7 08	2060
50	18 22	1682	61 56	1894	128 57	7637	50	7 10	2070
0	18 40	1700	62 22	1920	129 52	7688	34 0	7 13	2080
10	18 56	1718	62 49	1946	130 48	7740	10	7 15	2090
20	19 13	1736	63 15	1972	131 44	7791	20	7 18	2100
30	19 29	1754	63 42	1998	132 50	7842	30	7 20	2110
40	19 46	1772	64 09	2024	133 33	7894	40	7 22	2121
50	20 2	1790	64 34	2050	134 24	7945	50	7 24	2131
0	20 19	1808	65 02	2076	135 20	7995	35 0	7 27	2141
10	20 36	1826	65 31	2102	136 21	8048	10	7 29	2151
20	20 53	1844	65 56	2129	137 2	8098	20	7 31	2162
30	21 09	1862	66 26	2155	138 17	8150	30	7 34	2172
40	21 26	1880	66 50	2181	139 3	8201	40	7 36	2182
50	21 42	1898	67 15	2207	140 7	8253	50	7 38	2192

A Traverse Table to find the

3 Rumb.			3 Rumb.			4 Rumb.			5 Rumb.		
Long.		Lat.	Long.		Lat.	Long.		Lat.	Long.		Lat.
11	37	1753	18	45	1948	28	03	2391	42	00	2916
11	42	1764	18	48	1960	28	14	2405	42	17	2934
11	47	1775	19	00	1972	28	27	2419	42	33	2951
11	51	1780	19	07	1984	28	35	2433	42	50	2970
11	56	1797	19	15	1996	28	49	2448	43	07	2988
12	01	1808	19	22	2008	28	59	2462	43	24	3006
12	06	1818	19	30	2021	29	11	2476	43	41	3024
12	10	1829	19	37	2033	29	22	2490	43	58	3042
12	15	1840	19	45	2045	29	34	2504	44	15	3060
12	20	1851	19	50	2057	29	46	2518	44	32	3078
12	25	1862	20	00	2069	29	57	2532	44	49	3096
12	30	1872	20	08	2081	30	06	2547	45	06	3114
12	34	1883	20	16	2093	30	19	2561	45	23	3132
12	39	1894	20	23	2105	30	31	2575	45	40	3150
12	42	1905	20	30	2117	30	42	2589	45	57	3168
12	48	1916	20	38	2129	30	54	2603	46	15	3186
12	52	1927	20	46	2141	31	05	2617	46	32	3204
12	57	1937	20	54	2153	31	17	2631	46	49	3222
13	02	1948	21	01	2165	31	28	2646	47	06	3240
13	07	1959	21	09	2177	31	40	2660	47	23	3258
13	11	1970	21	17	2189	31	51	2674	47	41	3276
13	16	1981	21	24	2201	32	03	2688	47	58	3294
13	22	1992	21	32	2213	32	15	2702	48	16	3312
13	26	2002	21	40	2225	32	29	2716	48	33	3330
13	30	2013	21	47	2237	32	39	2730	48	50	3348
13	35	2024	21	55	2249	32	49	2745	49	08	3366
13	40	2035	22	03	2261	33	00	2759	49	25	3384
13	45	2046	22	11	2273	33	12	2773	49	53	3402
13	50	2056	22	19	2285	33	25	2787	50	01	3420
13	56	2067	22	27	2297	33	37	2801	50	18	3438

Difference of Longitude, and Distance.

1 Rumb.		2 Rumb.		4 Rumb.		5 Rumb.	
Long	Dist.	Long	Dist.	Long	Dist.	Long	Dist.
14 01	2708	22 30	2509	31 48	2715	50 36	1456
14 06	2089	22 42	2521	34 0.	2732	50 53	1474
14 10	2100	22 56	2535	34 12	2744	51 11	1492
14 15	2113	23 08	2545	34 24	2755	51 29	1510
14 20	2121	23 20	2557	34 36	2772	51 47	1528
14 25	2142	23 34	2569	34 48	2786	52 04	1546
14 30	2148	23 48	2581	35 00	2802	52 22	1564
14 35	2154	23 50	2593	35 12	2814	52 40	1582
14 40	2165	24 08	2605	35 23	2827	52 58	1600
14 45	2173	24 18	2617	35 35	2843	53 16	1618
14 50	2186	24 34	2629	35 47	2857	53 34	1636
14 56	2197	24 52	2641	35 59	2871	53 50	1654
14 59	2208	24 50	2654	36 11	2885	54 10	1672
15 04	2219	24 58	2666	36 23	2898	54 28	1690
15 09	2230	25 16	2678	36 36	2913	54 46	1708
15 14	2240	25 34	2690	36 47	2927	55 04	1726
15 20	2251	25 52	2702	36 59	2942	55 22	1744
15 25	2262	26 10	2714	37 12	2956	55 41	1762
15 29	2274	26 28	2726	37 24	2970	55 59	1780
15 34	2284	26 46	2738	37 36	2984	56 17	1798
15 39	2295	27 04	2750	37 48	2998	56 35	1816
15 44	2305	27 22	2762	38 00	3012	56 54	1834
15 50	2316	27 40	2774	38 13	3026	57 12	1852
15 55	2327	27 58	2786	38 25	3041	57 30	1870

A Traverse Table to find the

Lat.	6 Rumb.		7 Rumb.	
D. M.	Long.	Dif.	Long.	Dif.
27 0	69 27	43 1	141 04	85 04
10	69 53	43 19	141 01	85 55
20	70 18	43 38	142 56	86 06
30	70 44	43 56	143 51	86 58
40	71 09	44 13	144 49	87 00
50	71 35	44 30	145 46	87 62
28 0	72 01	44 46	146 44	88 11
10	72 27	45 02	147 33	88 62
20	72 53	45 18	148 33	89 14
30	73 19	45 33	149 31	89 65
40	73 45	45 48	150 31	90 16
50	74 11	46 03	151 29	90 68
29 0	74 37	46 17	152 28	91 19
10	75 03	46 31	153 24	91 70
20	75 29	46 45	154 23	92 21
30	75 55	46 58	155 19	92 73
40	76 21	47 11	156 17	93 24
50	76 48	47 24	157 16	93 75
30 0	77 14	47 36	158 15	94 26
10	77 40	47 48	159 14	94 78
20	78 06	48 00	160 08	95 29
30	78 33	48 12	161 08	95 80
40	78 59	48 23	162 07	96 31
50	79 25	48 34	163 05	96 83
31 0	79 52	48 45	164 03	97 34
10	80 18	48 56	165 01	97 85
20	80 45	49 06	166 01	98 36
30	81 11	49 16	167 00	98 88
40	81 38	49 26	168 00	99 39
50	82 04	49 36	169 00	99 90

Lat.	1 Rumb.		2 Rumb.	
D. M.	Long.	Dif.	Long.	Dif.
30 0	7 41	12 02	16 02	24 04
10	7 43	12 12	16 05	24 08
20	7 46	12 23	16 11	24 16
30	7 48	12 33	16 16	24 25
40	7 50	12 43	16 21	24 33
50	7 53	12 53	16 26	24 41
37 0	7 56	13 03	16 32	24 49
10	7 59	13 14	16 37	24 57
20	8 02	13 24	16 42	25 06
30	8 04	13 34	16 47	25 14
40	8 08	13 44	16 52	25 22
50	8 09	13 54	16 57	25 30
38 0	8 11	14 03	17 02	25 38
10	8 13	14 13	17 08	25 46
20	8 16	14 23	17 13	25 54
30	8 19	14 33	17 18	26 03
40	8 21	14 42	17 23	26 11
50	8 24	14 52	17 28	26 19
39 0	8 26	15 01	17 33	26 27
10	8 29	15 11	17 39	26 35
20	8 31	15 20	17 44	26 43
30	8 34	15 29	17 49	26 51
40	8 37	15 39	17 54	26 59
50	8 39	15 48	17 59	27 07
40 0	8 42	15 57	18 05	27 15
10	8 44	16 07	18 11	27 23
20	8 47	16 16	18 16	27 31
30	8 49	16 25	18 22	27 39
40	8 52	16 34	18 28	27 47
50	8 55	16 43	18 34	27 55

Difference of Longitude and Distance.

Lat.	6 Rumb.		7 Rumb.	
D. M.	Long.	dist.	Long.	dist.
0	31 35	1017	170 00	9841
10	32 06	0433	170 55	9893
20	32 23	1069	171 51	9944
30	33 03	1093	172 50	9995
40	33 30	1122	173 50	10047
50	34 01	1148	174 52	10099
0	34 29	1174	175 54	10149
10	34 56	1200	176 55	10200
20	35 24	1226	177 56	10252
30	35 52	1252	178 57	10303
40	36 20	1278	179 58	10354
50	36 51	1305	180 57	10405
0	37 24	1331	181 56	10457
10	37 57	1357	182 57	10508
20	38 30	1383	183 59	10559
30	38 50	1409	184 59	10610
40	39 21	1435	185 58	10662
50	39 49	1461	187 00	10713
0	40 19	1487	188 02	10764
10	40 49	1514	189 05	10815
20	41 18	1540	190 04	10867
30	41 48	1566	191 06	10918
40	42 17	1592	192 09	10969
50	42 48	1618	193 11	11020

Lat.	1 Rumb.		2 Rumb.	
D. M.	Long.	dist.	Long.	dist.
41 0	1 37	1300	98 40	2663
10	2 00	1326	98 45	2674
20	2 03	1352	98 50	2684
30	2 06	1378	98 56	2695
40	2 08	1404	99 01	2706
50	2 11	1430	99 06	2717
42 0	2 14	1456	99 11	2728
10	2 17	1482	99 18	2739
20	2 19	1508	99 23	2749
30	2 21	1534	99 29	2760
40	2 24	1560	99 35	2771
50	2 27	1586	99 40	2782
43 0	2 30	1611	99 46	2793
10	2 31	1636	99 51	2803
20	2 35	1662	99 57	2814
30	2 37	1687	100 03	2825
40	2 40	1713	100 08	2836
50	2 43	1738	100 13	2847
44 0	2 46	1764	100 18	2858
10	2 48	1790	100 26	2869
20	2 51	1815	100 32	2879
30	2 54	1841	100 38	2890
40	2 57	1867	100 44	2901
50	3 00	1894	100 50	2912

A Traverse Table to find the

3 Rumb.			4 Rumb.			5 Rumb.			6 Rumb.		
Long.		dif.	Long.		dif.	Long.		dif.	Long.		dif.
25	49	2358	38	38	3031	57	49	3826	93	8	10 4
25	57	2813	38	50	3069	58	08	3906	94	41	672
26	05	2622	39	04	3082	58	30	3924	94	10	1097
26	1	2634	39	15	3097	58	48	3942	94	49	7-8
26	21	2646	39	27	3111	59	03	3960	95	10	3741
26	30	2658	39	40	3125	59	21	3978	95	48	1995
26	39	2670	39	53	3140	59	41	3996	96	18	1821
26	47	2681	40	01	3154	60	00	4014	96	48	1827
26	55	2693	40	18	3168	60	18	4032	97	18	1833
27	03	705	40	31	3182	60	37	4050	97	48	1839
27	12	2717	40	45	3196	60	56	4068	98	19	1206
27	20	2729	40	58	3210	61	15	4086	98	49	1212
27	29	2741	41	05	3224	61	34	4104	99	19	1218
27	37	2753	41	21	3239	61	52	4122	99	49	1224
27	45	2765	41	35	3253	62	12	4140	100	20	1230
27	54	2778	41	48	3268	62	31	4158	100	50	1236
28	03	2790	42	02	3281	62	50	4176	101	21	1242
28	11	2802	42	15	3296	63	09	4194	101	51	1248
28	20	2814	42	29	3309	63	29	4212	102	22	1254
28	28	2826	42	39	3323	63	48	4230	102	52	1260
28	37	2838	42	52	3338	64	07	4248	103	23	1267
28	45	2850	43	04	3352	64	27	4266	103	53	1273
28	53	2862	43	17	3366	64	46	4284	104	24	1279
29	04	2874	43	30	3380	65	06	4302	104	54	1285
29	12	2886	43	43	3394	65	25	4320	105	25	1291
29	21	2898	43	56	3408	65	45	4338	105	56	1298
29	30	2910	44	09	3422	66	04	4356	106	26	1304
29	38	2923	44	21	3437	66	24	4374	106	57	1310
29	47	2935	44	34	3451	66	44	4392	107	28	1316
29	56	2947	44	48	3465	67	04	4410	107	58	1322

Difference of Longitude, and Distance.

3 Rumb.		4 Rumb.		5 Rumb.		6 Rumb.	
Long.	Dist.	Long.	dist.	Long.	dist.	Long.	dist.
30 05	2972	45 08	3472	67 11	4418	108 42	5128
30 10	2978	45 16	3482	67 21	4436	109 16	5154
30 15	2985	45 24	3507	68 01	4454	109 46	5180
30 20	2992	45 32	3518	68 21	4472	110 20	5207
30 25	3000	45 40	3515	68 41	4490	110 52	5233
30 30	3019	45 48	3510	69 01	4508	111 25	5259
30 00	3038	46 22	3504	69 21	4526	111 58	5285
31 08	3043	46 36	3574	69 41	4544	112 29	5311
31 17	3055	46 49	3592	70 04	4572	113 01	5337
31 26	3067	47 03	3606	70 24	4590	113 30	5363
31 35	3079	47 16	3619	70 44	4608	114 00	5390
31 44	3091	47 30	3614	71 04	4626	114 29	5716
31 53	3103	47 43	3649	71 25	4644	115 12	5742
32 20	3115	47 56	3663	71 45	4662	115 45	5768
32 11	3127	48 10	3677	72 06	4680	116 19	5794
32 20	3139	48 25	3691	72 27	4698	116 51	5820
32 29	3151	48 39	3715	72 47	4716	117 27	5846
32 38	3163	48 54	3719	73 08	4734	117 55	5872
32 47	3175	49 08	3713	73 29	4752	118 34	5899
32 57	3187	49 20	3748	73 50	4770	119 06	5925
33 07	3199	49 34	3762	74 11	4788	119 40	5951
33 10	3211	49 48	3776	74 31	4806	120 11	5977
33 25	3223	50 02	3790	74 52	4824	120 45	7003
33 34	3235	50 16	3804	75 12	4842	121 21	7029

A Traverſe Table to find the

7 Rumb.			1	1 Rumb.		1 Rumb.		2 Rumb.	
Long.	Lat.		Lat. M.	Long.	Lat.	Long.	dif.	Long.	Lat.
194 14	11074		45	10 03	27 3	20 56	1925	33 48	1
195 17	11123		1	10 06	2763	21 01	2931	33 53	33
196 18	11174		2	10 08	2773	1 07	2944	34 02	3
197 20	11226		3	10 11	2782	21 13	2957	34 12	2
198 22	11277		4	10 14	2796	21 19	2970	4 23	3
199 24	11328		5	10 18	2804	21 24	2977	34 31	3
200 24	11379		46 0	10 19	28 4	21 31	2988	34 42	3
201 31	11431		10	10 22	2814	21 37	2998	34 52	3
202 33	11472		20	10 25	2833	21 42	3009	35 01	3
203 37	11423		3	10 28	2845	21 48	3029	35 21	3
204 41	11574		42	10 31	2853	21 54	3031	35 21	3
205 46	11626		50	10 4	2865	22 00	3041	35 30	3
206 50	11687		47 0	10 37	2875	22 06	3052	35 40	3
207 54	11738		10	10 40	2810	22 11	3063	35 50	3
208 55	11789		20	10 43	2890	22 18	3074	36 00	3
210 06	11842		3	10 45	2900	22 24	3085	36 10	3
211 05	11892		40	10 48	910	22 30	3096	36 20	3
212 10	11941		50	10 51	2926	22 36	3106	36 30	3
213 15	11994		48 0	10 54	2936	22 41	3115	36 40	3
214 20	12046		10	10 57	2947	22 47	3126	36 50	3
215 24	12097		20	11 00	2957	22 52	3136	37 00	3
216 29	12148		3	11 04	2967	22 58	3150	37 10	3
217 35	12199		40	11 07	2977	23 10	3164	37 20	3
218 41	12251		50	11 10	2987	23 16	3174	37 30	3
219 42	12302		49 0	11 13	2998	23 22	3184	37 40	3
220 49	12353		10	11 16	3008	23 27	3193	37 50	3
221 56	12404		20	11 19	3018	23 33	3204	38 00	3
223 03	12456		30	11 22	3028	23 40	3215	38 10	3
224 18	12507		40	11 25	3038	23 46	3225	38 20	3
225 11	12558		50	11 28	3049	23 52	3236	38 30	3

| 7 Rumb. | | |

A Traverse Table to find the

4 Rumb.		5 Rumb.		6 Rumb.		7 Rumb.	
Long.	dist.	Long.	dist.	Long.	dist.	Long.	dist.
30 34	3818	75 33	4060	121 56	7055	253 34	14840
30 40	3832	75 56	4078	122 30	7082	255 04	14861
30 57	3847	76 17	4096	123 04	7108	256 11	14942
31 14	3861	76 38	4114	123 38	7134	257 24	15003
31 21	3875	77 00	4132	124 13	7160	258 38	15065
31 40	3889	77 21	4150	124 47	7186	259 50	15096
31 54	3903	77 43	4168	125 22	7212	261 04	15157
32 12	3917	78 04	4186	125 56	7238	262 19	15158
32 25	3931	78 28	5004	126 31	7264	263 28	15239
32 39	3946	78 47	5022	127 08	7291	264 39	15311
32 54	3960	79 07	5040	127 43	7317	265 51	15352
33 10	3974	79 30	5058	128 18	7343	267 08	15403
33 23	3988	79 53	5076	128 53	7369	268 23	15435
33 37	4002	80 15	5094	129 28	7395	269 22	15506
33 52	4016	80 37	5112	130 04	7422	270 47	15557
34 06	4030	80 59	5130	130 40	7447	272 02	15609
34 21	4045	81 21	5148	131 15	7473	273 18	15660
34 35	4059	81 43	5166	131 52	7500	274 34	15711
34 52	4073	82 06	5184	132 28	7526	275 50	15762
35 05	4087	82 28	5202	133 05	7552	277 06	15814
35 22	4101	82 51	5220	133 38	7578	278 17	15865
35 37	4115	83 14	5238	134 16	7604	279 34	15916
35 51	4130	83 36	5256	134 54	7630	280 51	15967
36 07	144	83 58	5274	135 28	7656	282 06	16019
36 22	4158	84 22	5292	136 07	7683	283 21	16070
36 38	4172	84 42	5310	136 42	7709	284 38	16122
36 52	4186	85 07	5328	137 20	7735	285 56	16172
37 08	4200	85 30	5346	137 57	7761	287 14	16224
37 21	4214	85 54	5364	138 34	7787	288 31	16275
37 37	4228	86 16	5382	139 12	7813	289 40	16326

A Traverſe Table to find the

4 Rumb.		5 Rumb.		6 Rumb.		7 Rumb.	
Long.	dift.	Long.	dift.	Long.	dift.	Long.	dift.
54	4243	80 44	5400	139 49	7819	194 05	15377
10	4255	87 03	5418	140 26	7865	293 24	15429
26	4271	87 27	5426	141 04	7892	295 44	15480
42	4285	87 50	5434	141 41	7918	296 04	15531
58	4299	88 18	5472	142 20	7944	296 24	15582
14	4313	88 39	5480	142 58	7970	297 45	15634
30	4327	89 01	5508	143 36	7996	299 00	15685
46	4342	89 23	5536	144 17	8022	300 21	15736
02	4356	89 49	5544	144 53	8048	301 43	15477
17	4370	90 13	5562	145 31	8074	303 04	15819
33	4384	90 37	5580	146 12	8101	304 20	15890
49	4398	91 00	5598	146 51	8121	305 42	15624
05	4412	91 25	5616	147 30	8153	307 05	15924
21	4426	91 50	5634	148 09	8179	308 28	160 4
37	4441	92 14	5652	148 48	8205	309 52	16045
54	4455	92 39	5670	149 28	8231	311 13	16146
10	4469	93 03	5688	150 07	8257	312 36	16198
26	4483	93 28	5606	150 47	8284	313 57	16249
43	4497	93 53	5724	151 27	8310	315 22	16300
00	4511	94 18	5742	152 07	8336	316 46	16351
17	4525	94 43	5760	152 47	8362	318 12	16403
34	4540	95 03	5778	153 27	8388	319 33	16454
51	4554	95 33	5796	154 11	8414	320 56	16505
68	4568	95 58	5814	154 48	8440	322 23	6556
24	4582	96 24	5832	155 32	8467	323 49	16608
41	4596	96 48	5850	156 13	8493	325 10	16659
58	4610	97 15	5868	156 54	8519	326 40	16710
15	4624	97 42	5886	157 36	8545	328 04	16761
32	4638	98 07	5904	158 27	8571	329 33	16813
50	4653	98 37	5922	158 58	8597	329 01	16864

A Traverse Table to find the

Lat.		1 Rumb.		2 Rumb.		3 Rumb.		4 Rumb.	
D.	M.	Long.	dist.	Long.	dist.	Long.	dist.	Long.	dist.
53	0	13 07	21305	27 21	33170	44 9	37151	60 0	46[illegible]
	10	13 11	21375	27 27	33252	44 21	37281	60 24	46611
	20	13 16	21383	27 36	33293	44 31	37353	60 42	46711
	30	13 19	21393	27 45	33404	44 41	37465	60 [illegible]	46[illegible]
	40	13 23	21460	27 54	33514	44 57	37617	60 [illegible]	47[illegible]
	50	13 28	21525	28 7	33626	45 09	37730	60 [illegible]	47[illegible]
54	0	13 30	21626	28 06	33736	45 22	37841	60 54	47[illegible]
	10	13 33	21686	28 15	33848	45 34	37952	60 [illegible]	47[illegible]
	20	13 36	21746	28 24	33958	45 46	38063	60 [illegible]	47[illegible]
	30	13 39	21806	28 [illegible]	34069	45 58	38177	60 [illegible]	47[illegible]
	40	13 42	21866	28 33	34180	46 10	38289	60 [illegible]	48[illegible]
	50	13 45	21926	28 42	34291	46 22	38401	60 [illegible]	48[illegible]
55	0	13 51	22047	28 [illegible]	34507	46 34	38613	60 [illegible]	48[illegible]
	10	13 54	22107	28 57	34718	46 46	38825	60 [illegible]	48[illegible]
	20	13 57	22167	29 03	34825	46 57	38937	60 [illegible]	48[illegible]
	30	14 01	22227	29 12	34934	47 10	39049	60 [illegible]	49[illegible]
	40	14 04	22287	29 18	35045	47 22	39161	60 [illegible]	49[illegible]
	50	14 07	22347	29 24	35156	47 34	39273	60 [illegible]	49[illegible]
56	0	14 11	22446	29 36	35366	47 49	39485	60 [illegible]	49[illegible]
	10	14 15	22518	29 45	35477	48 00	39597	60 [illegible]	49[illegible]
	20	14 18	22568	29 54	35587	48 12	39709	60 [illegible]	49[illegible]
	30	14 21	22578	30 00	35699	48 26	39821	60 [illegible]	50[illegible]
	40	14 24	22588	30 06	35810	48 40	39933	60 [illegible]	50[illegible]
	50	14 27	22598	30 12	35921	48 54	40045	60 [illegible]	50[illegible]
57	0	14 30	22659	30 24	36132	49 05	40257	60 [illegible]	50[illegible]
	10	14 39	22819	30 30	36242	49 17	40369	60 [illegible]	50[illegible]
	20	14 42	22879	30 36	36353	49 29	40481	60 [illegible]	50[illegible]
	30	14 45	22939	30 42	36463	49 41	40593	60 [illegible]	50[illegible]
	40	14 48	22999	30 48	36574	49 53	40705	60 [illegible]	50[illegible]
	50	14 51	23059	31 [illegible]	36686	49 58	40817	60 [illegible]	50[illegible]

Difference of Longitude and Distance.

Lat.	1 Rumb.		2 Rumb.		3 Rumb.		4 Rumb.	
D.M.	Long.	dist.	Long.	dist.	Long.	dist.	Long.	dist.
60 0	15 00	3570	31 15	3597	50 25	4330	75 27	5031
10	15 03	3580	31 21	3607	50 36	4342	75 41	5045
20	15 06	3590	31 27	3618	50 48	4354	75 55	5059
30	15 12	3600	31 37	3629	51 05	4367	76 17	5073
40	15 15	3610	31 43	3640	51 17	4379	76 31	5087
50	15 18	3620	31 54	3650	51 29	4390	76 45	5101
61 0	15 21	3632	32 00	3661	51 41	4402	77 00	5115
10	15 24	3642	32 15	3672	52 01	4414	77 14	5129
20	15 27	3652	32 21	3683	52 13	4426	77 29	5144
30	15 36	3662	32 30	3694	52 27	4438	77 43	5158
40	15 36	3672	32 36	3705	52 39	4450	77 58	5172
50	15 45	3682	32 45	3716	52 56	4462	78 12	5186
62 0	15 48	3693	32 57	3727	53 09	4474	78 33	5201
10	15 51	3703	33 03	3738	53 21	4486	78 57	5215
20	15 54	3713	33 12	3749	53 39	4498	79 15	5229
30	16 00	3723	33 18	3760	53 54	4510	79 39	5243
40	16 03	3733	33 31	3771	54 07	4522	80 00	5257
50	16 06	3743	33 43	3782	54 20	4534	80 21	5271
63 0	16 15	3754	33 51	3793	54 37	4546	80 45	5286
10	16 18	3764	34 00	3804	55 10	4558	81 06	5300
20	16 21	3774	34 09	3815	55 05	4570	81 27	5314
30	16 27	3784	34 18	3826	55 22	4582	81 51	5328
40	16 33	3794	34 27	3837	55 39	4594	82 12	5342
50	16 31	3804	34 36	3848	55 55	4606	82 34	5356
64	16 39	3814	34 45	3857	56 16	4618	83 57	5424

A Traverse Table to find the

5 Rumb.			6 Rumb.			7 Rumb.		
Long.		Dif.	Long.		Dif.	Long.		Dif.
98	55	5940	159	25	8021	333	18	16911
99	13	5957	160	18	8649	333	48	16911
99	49	5973	161	02	8676	335	18	17022
100	16	5992	161	45	8702	336	48	17047
100	43	6010	162	30	8728	338	06	17116
101	10	6027	163	14	8754	339	35	17181
101	37	6048	163	55	8781	341	27	17321
102	04	6065	164	40	8808	342	57	17381
102	31	6082	165	18	8832	343	27	17512
102	54	6100	165	58	8856	345	36	17579
103	21	6120	166	39	8885	346	06	17621
103	52	6138	167	20	8911	347	26	17681
104	18	6156	168	18	89 7	350	44	17751
104	45	6173	168	59	8963	351	54	17771
105	13	6191	169	02	8989	353	4	17841
105	4	6209	170	17	9015	354	54	17961
106	06	6228	171	09	9042	356	24	17771
106	33	6245	171	58	9066	357	57	17751
107	50	6264	172	45	9094	359	52	17871
107	45	6282	173	31	9122	361	22	17951
108	03	6299	174	20	9144	362	52	17961
108	30	6318	175	03	9177	364	27	17981
108	57	6336	175	45	9199	365	57	18031
109	27	6353	176	30	9224	367	27	18101
109	55	6371	177	18	9251	369	15	18161
110	23	6389	178	09	9276	370	45	18191
110	50	6409	178	59	9303	372	25	18251
111	27	6426	179	58	9330	374	24	18301
111	54	6441	180	35	9355	375	54	18361
112	23	6462	181	18	9381	377	54	18401

Difference of Longitude and Distance.

5 Rumb.		6 Rumb.		7 Rumb.	
Long.	dist.	Long.	dist.	Long.	dist.
118 30	6.79	182 30	9.07	337 [illegible]	[illegible]
118 27	6497	182 52	9434	380 [illegible]	[illegible]
118 59	6516	183 40	9462	232	[illegible]
114 30	6534	184 30	9486	334 21	[illegible]
114 57	6552	185 19	9502	285 57	[illegible]
115 29	6570	181 18	9537	237 31	[illegible]
115 55	6588	187 00	9504	389 41	[illegible]
116 24	6606	187 48	9510	340 51	[illegible]
116 58	6623	188 42	9617	342 28	[illegible]
117 29	6642	189 30	9642	394 39	[illegible]
117 59	6660	190 22	9663	395 24	[illegible]
118 32	6678	191 00	9695	398 09	[illegible]
119 03	66 6	192 03	9721	399 57	[illegible]
119 34	6714	192 51	9747	401 42	[illegible]
120 05	6731	193 48	9773	403 36	[illegible]
120 42	6749	194 42	9800	405 30	[illegible]
121 21	6766	195 30	9826	407 25	[illegible]
121 54	6786	196 18	9852	409 00	[illegible]
122 22	6804	197 22	9878	411 00	[illegible]
122 58	6822	198 48	9904	412 50	[illegible]
123 32	6840	199 37	9930	414 02	[illegible]
124 09	68 7	200 24	9956	416 26	[illegible]
124 29	[illegible]	201 10	9982	418 24	[illegible]
124 49	6894	201 58	10008	420 10	[illegible]
125 38	6912	202 42	10034	422 03	19686

A Table to reduce Miles of Eafting,

Point.	1 Mile.			2 Mile.			3 Miles.			4 Miles.			5 Mile.		
	d.	m.	f.	d.	m.	f.	d.	m.	f.	d.	m.	f.	d.	m.	f.
0	0	1	0	0	2	0	0	3	0	0	4	0	0	5	0
1	0	1	0	0	2	0	0	3	0	0	4	0	0	5	0
2	0	1	0	0	2	0	0	3	0	0	4	0	0	5	0
3	0	1	0	0	2	0	0	3	0	0	4	0	0	5	0
4	0	1	0	0	2	0	0	3	0	0	4	0	0	5	0
5	0	1	0	0	2	0	0	3	1	0	4	1	0	5	1
6	0	1	0	0	2	1	0	3	1	0	4	1	0	5	1
7	0	1	0	0	2	1	0	3	1	0	4	1	0	5	1
8	0	1	1	0	2	1	0	3	1	0	4	2	0	5	2
9	0	1	1	0	2	1	0	3	2	0	4	2	0	5	2
10	0	1	1	0	2	2	0	3	2	0	4	3	0	5	2
11	0	1	1	0	2	2	0	3	3	0	4	4	0	5	3
12	0	1	2	0	2	2	0	3	3	0	4	4	0	5	3
13	0	1	2	0	2	3	0	3	4	0	4	5	0	5	4
14	0	1	2	0	2	4	0	3	5	0	4	6	0	5	4
15	0	1	2	0	2	4	0	3	5	0	4	7	0	5	4
16	0	1	2	0	2	5	0	3	6	0	4	8	0	5	5
17	0	1	3	0	2	6	0	3	7	0	4	10	0	5	6
18	0	1	3	0	2	6	0	3	8	0	4	11	0	5	6
19	0	1	3	0	2	7	0	3	9	0	4	12	0	5	7
							0	3	10	0	4	14	0	5	7

20	0	1	4	0	2	8	0	3	12	0	4	15	0	5	18
21	0	1	4	0	2	9	0	3	13	0	4	17	0	5	21
22	0	1	5	0	2	9	0	3	14	0	4	19	0	5	24
23	0	1	5	0	2	10	0	3	16	0	4	21	0	5	26
24	0	1	6	0	2	11	0	3	17	0	4	23	0	5	28
25	0	1	6	0	2	12	0	3	19	0	4	25	0	5	31
26	0	1	7	0	2	13	0	3	20	0	4	27	0	5	34
27	0	1	7	0	2	14	0	3	22	0	4	29	0	5	37
28	0	1	8	0	2	16	0	3	24	0	4	31	0	5	39
29	0	1	9	0	2	17	0	3	26	0	4	34	0	5	42
30	0	1	9	0	2	19	0	3	28	0	4	37	0	5	46
31	0	1	10	0	2	20	0	3	30	0	4	40	0	5	50
32	0	1	11	0	2	21	0	3	32	0	4	43	0	5	54
33	0	1	12	0	2	23	0	3	35	0	4	46	0	5	58
34	0	1	12	0	2	25	0	3	37	0	4	50	0	6	02
35	0	1	13	0	2	26	0	3	40	0	4	53	0	6	06
36	0	1	14	0	2	28	0	3	42	0	4	57	0	6	11
37	0	1	15	0	2	30	0	3	45	0	5	01	0	6	16
38	0	1	16	0	2	32	0	3	48	0	5	05	0	6	21
39	0	1	17	0	2	34	0	3	52	0	5	09	0	6	26
40	0	1	18	0	2	37	0	3	55	0	5	13	0	6	32
41	0	1	19	0	2	39	0	3	58	0	5	18	0	6	37
42	0	1	21	0	2	41	0	4	01	0	5	23	0	6	44
43	0	1	22	0	2	44	0	4	06	0	5	28	0	6	50
44	0	1	23	0	2	47	0	4	10	0	5	34	0	6	57

A Table to reduce Miles of Eafting, c

Parall.	6 Mile.			7 Mile.			8 Miles.			9 Miles.			10 Mile.			20 Mi
	d.	m.	f.	d.	m.	f.	d.	m.	f.	d.	m.	f.	d.	m.	f.	d. m.
0	0	6	0	0	7	0	0	8	0	0	9	0	0	10	0	0 20
1	0	6	0	0	7	0	0	8	0	0	9	0	0	10	0	0 20
2	0	6	0	0	7	0	0	8	0	0	9	1	0	10	1	0 20
3	0	6	0	0	7	1	0	8	1	0	9	1	0	10	1	0 20
4	0	6	1	0	7	1	0	8	1	0	9	1	0	10	1	0 21
5	0	6	1	0	7	1	0	8	1	0	9	1	0	10	1	0 22
6	0	6	1	0	7	1	0	8	1	0	9	2	0	10	2	0 22
7	0	6	1	0	7	1	0	8	1	0	9	2	0	10	2	0 23
8	0	6	1	0	7	1	0	8	1	0	9	2	0	10	2	0 23
9	0	6	1	0	7	1	0	8	1	0	9	2	0	10	2	0 23
10	0	6	2	0	7	2	0	8	2	0	9	3	0	10	3	0 23
11	0	6	2	0	7	2	0	8	2	0	9	3	0	10	3	0 24
12	0	6	2	0	7	2	0	8	2	0	9	3	0	10	3	0 24
13	0	6	2	0	7	2	0	8	2	0	9	3	0	10	3	0 24
14	0	6	2	0	7	2	0	8	2	0	9	3	0	10	3	0 24
15	0	6	3	0	7	3	0	8	3	0	9	4	0	10	4	0 25
16	0	6	3	0	7	3	0	8	3	0	9	4	0	10	4	0 25
17	0	6	3	0	7	3	0	8	3	0	9	4	0	10	4	0 25
18	0	6	3	0	7	3	0	8	3	0	9	4	0	10	4	0 25
19	0	6	3	0	7	3	0	8	3	0	9	4	0	10	4	0 25
20	0	6	4	0	7	4	0	8	4	0	9	5	0	10	5	0 26
21	0	6	4	0	7	4	0	8	4	0	9	5	0	10	5	0 26
22	0	6	4	0	7	4	0	8	4	0	9	5	0	10	5	0 26
23	0	6	4	0	7	4	0	8	4	0	9	5	0	10	5	0 26
24	0	6	4	0	7	4	0	8	4	0	9	5	0	10	5	0 26
25	0	6	5	0	7	5	0	8	5	0	9	6	0	10	6	0 27
26	0	6	5	0	7	5	0	8	5	0	9	6	0	10	6	0 27
27	0	6	5	0	7	5	0	8	5	0	9	6	0	10	6	0 27
28	0	6	5	0	7	5	0	8	5	0	9	6	0	10	6	0 27
29	0	6	5	0	7	5	0	8	5	0	9	6	0	10	6	0 27
30	0	6	6	0	7	6	0	8	6	0	9	7	0	10	7	0 28
31	0	6	6	0	7	6	0	8	6	0	9	7	0	10	7	0 28
32	0	6	6	0	7	6	0	8	6	0	9	7	0	10	7	0 28
33	0	6	6	0	7	6	0	8	6	0	9	7	0	10	7	0 28
34	0	6	6	0	7	6	0	8	6	0	9	7	0	10	7	0 28
35	0	6	7	0	7	7	0	8	7	0	9	8	0	10	8	0 29
36	0	6	7	0	7	7	0	8	7	0	9	8	0	10	8	0 29
37	0	6	7	0	7	7	0	8	7	0	9	8	0	10	8	0 29
38	0	6	7	0	7	7	0	8	7	0	9	8	0	10	8	0 29
39	0	6	7	0	7	7	0	8	7	0	9	8	0	10	8	0 29
40	0	6	8	0	7	8	0	8	8	0	9	9	0	10	9	0 30
41	0	6	8	0	7	8	0	8	8	0	9	9	0	10	9	0 30
42	0	6	8	0	7	8	0	8	8	0	9	9	0	10	9	0 30
43	0	6	8	0	7	8	0	8	8	0	9	9	0	10	9	0 30
44	0	6	8	0	7	8	0	8	8	0	9	9	0	10	9	0 30
45	0	6	9	0	7	9	0	8	9	0	9	10	0	10	10	0 31
46	0	6	9	0	7	9	0	8	9	0	9	10	0	10	10	0 31
47	0	6	9	0	7	9	0	8	9	0	9	10	0	10	10	0 31
48	0	6	9	0	7	9	0	8	9	0	9	10	0	10	10	0 31
49	0	6	9	0	7	9	0	8	9	0	9	10	0	10	10	0 31
50	0	6	10	0	7	10	0	8	10	0	9	11	0	10	11	0 32
51	0	6	10	0	7	10	0	8	10	0	9	11	0	10	11	0 32
52	0	6	10	0	7	10	0	8	10	0	9	11	0	10	11	0 32
53	0	6	10	0	7	10	0	8	10	0	9	11	0	10	11	0 32
54	0	6	10	0	7	10	0	8	10	0	9	11	0	10	11	0 32
55	0	6	11	0	7	11	0	8	11	0	9	12	0	10	12	0 33
56	0	6	11	0	7	11	0	8	11	0	9	12	0	10	12	0 33
57	0	6	11	0	7	11	0	8	11	0	9	12	0	10	12	0 33
58	0	6	11	0	7	11	0	8	11	0	9	12	0	10	12	0 33
59	0	6	11	0	7	11	0	8	11	0	9	12	0	10	12	0 33
60	0	6	12	0	7	12	0	8	12	0	9	13	0	10	13	0 34
61	0	6	12	0	7	12	0	8	12	0	9	13	0	10	13	0 34
62	0	6	12	0	7	12	0	8	12	0	9	13	0	10	13	0 34
63	0	6	12	0	7	12	0	8	12	0	9	13	0	10	13	0 34
64	0	6	12	0	7	12	0	8	12	0	9	13	0	10	13	0 34
65	0	6	13	0	7	13	0	8	13	0	9	14	0	10	14	0 35
66	0	6	13	0	7	13	0	8	13	0	9	14	0	10	14	0 35
67	0	6	13	0	7	13	0	8	13	0	9	14	0	10	14	0 35
68	0	6	13	0	7	13	0	8	13	0	9	14	0	10	14	0 35
69	0	6	13	0	7	13	0	8	13	0	9	14	0	10	14	0 35
70	0	6	14	0	7	14	0	8	14	0	9	15	0	10	15	0 36
71	0	6	14	0	7	14	0	8	14	0	9	15	0	10	15	0 36
72	0	6	14	0	7	14	0	8	14	0	9	15	0	10	15	0 36
73	0	6	14	0	7	14	0	8	14	0	9	15	0	10	15	0 36
74	0	6	14	0	7	14	0	8	14	0	9	15	0	10	15	0 36
75	0	6	15	0	7	15	0	8	15	0	9	16	0	10	16	0 37
76	0	6	15	0	7	15	0	8	15	0	9	16	0	10	16	0 37
77	0	6	15	0	7	15	0	8	15	0	9	16	0	10	16	0 37
78	0	6	15	0	7	15	0	8	15	0	9	16	0	10	16	0 37
79	0	6	15	0	7	15	0	8	15	0	9	16	0	10	16	0 37
80	0	6	16	0	7	16	0	8	16	0	9	17	0	10	17	0 38
81	0	6	16	0	7	16	0	8	16	0	9	17	0	10	17	0 38
82	0	6	16	0	7	16	0	8	16	0	9	17	0	10	17	0 38
83	0	6	16	0	7	16	0	8	16	0	9	17	0	10	17	0 38
84	0	6	16	0	7	16	0	8	16	0	9	17	0	10	17	0 38
85	0	6	17	0	7	17	0	8	17	0	9	19	0	10	18	0 39
86	0	6	17	0	7	17	0	8	17	0	9	19	0	10	18	0 39
87	0	6	17	0	7	17	0	8	17	0	9	19	0	10	18	0 39
88	0	6	17	0	7	17	0	8	17	0	9	19	0	10	18	0 39
89	0	6	17	0	7	17	0	8	17	0	9	19	0	10	18	0 39
90	0	6	18	0	7	18	0	8	18	0	9	20	0	10	20	0 40

20	0	6	22	0	7	05	0	8	27	0	9	34	0	10	38	0	11	37
21	0	6	26	0	7	30	0	8	44	0	9	48	0	10	43	0	11	35
22	0	6	28	0	7	34	0	8	38	0	9	43	0	10	47	0	11	34
23	0	6	31	0	7	37	0	8	41	0	9	47	0	10	52	0	11	44
24	0	6	33	0	7	39	0	8	44	0	9	50	0	10	57	0	11	54
25	0	6	37	0	7	43	0	8	50	0	9	56	0	11	02	0	12	04
26	0	6	40	0	7	47	0	8	54	0	10	01	0	11	07	0	12	15
27	0	6	42	0	7	51	0	8	58	0	10	06	0	11	12	0	12	27
28	0	6	47	0	7	57	0	9	03	0	10	11	0	11	17	0	12	37
29	0	6	51	0	8	02	0	9	09	0	10	17	0	11	24	0	12	54
30	0	6	56	0	8	08	0	9	14	0	10	24	0	11	33	0	12	06
31	0	7	00	0	8	12	0	9	20	0	10	30	0	11	40	0	12	19
32	0	7	04	0	8	18	0	9	26	0	10	37	0	11	47	0	12	33
33	0	7	09	0	8	21	0	9	31	0	10	44	0	11	55	0	12	51
34	0	7	14	0	8	27	0	9	38	0	10	51	0	11	04	0	13	08
35	0	7	19	0	8	33	0	9	46	0	10	59	0	12	12	0	13	25
36	0	7	25	0	8	40	0	9	53	0	11	06	0	12	21	0	13	43
37	0	7	31	0	8	48	0	10	01	0	11	16	0	12	30	0	13	03
38	0	7	37	0	8	55	0	10	09	0	11	25	0	12	41	0	13	24
39	0	7	43	0	9	02	0	10	18	0	11	35	0	12	52	0	13	40
40	0	7	50	0	9	09	0	10	27	0	11	45	0	13	03	0	14	00
41	0	7	57	0	9	16	0	10	36	0	11	55	0	13	15	0	14	20
42	0	8	04	0	9	25	0	10	46	0	12	07	0	13	27	0	14	54
43	0	8	12	0	9	34	0	10	56	0	12	20	0	13	40	0	15	25
44	0	8	21	0	9	44	0	11	07	0	12	31	0	13	54	0	15	48

A Table to reduce Miles of Easting, or

Point.	1 Mile.	2 Miles.	3 Miles.	4 Miles.	5 Miles.
	d. m. f.	d. m. f.	d. m. f.	d. m. f.	d. m. f.
45	0 1 25	0 2 50	0 4 15	0 5 39	0 7 4
46	0 1 26	0 2 53	0 4 19	0 5 45	0 7 12
47	0 1 28	0 2 56	0 4 24	0 5 51	0 7 21
48	0 1 30	0 2 59	0 4 29	0 5 59	0 7 28
49	0 1 31	0 3 03	0 4 34	0 6 06	0 7 37
50	0 1 33	0 3 07	0 4 40	0 6 13	0 7 47
51	0 1 35	0 3 11	0 4 46	0 6 21	0 7 57
52	0 1 37	0 3 14	0 4 52	0 6 30	0 8 07
53	0 1 40	0 3 19	0 4 59	0 6 38	0 8 18
54	0 1 42	0 3 24	0 5 06	0 6 47	0 8 30
55	0 1 45	0 3 29	0 5 14	0 6 59	0 8 43
56	0 1 47	0 3 35	0 5 27	0 7 09	0 8 56
57	0 1 50	0 3 40	0 5 30	0 7 21	0 9 11
58	0 1 53	0 3 46	0 5 40	0 7 33	0 9 26
59	0 1 56	0 3 53	0 5 49	0 7 46	0 9 42
60	0 2 00	0 4 00	0 6 00	0 8 00	0 10 00
61	0 2 04	0 4 07	0 6 11	0 8 15	0 10 19
62	0 2 08	0 4 16	0 6 23	0 8 31	0 10 38
63	0 2 12	0 4 24	0 6 36	0 8 49	0 11 01
64	0 2 17	0 4 34	0 6 51	0 9 07	0 11 24

65	0	2	22	0	4	44	0	7	06	0	9	28	0	11	50
66	0	2	28	0	4	45	0	7	23	0	9	50	0	12	16
67	0	2	33	0	5	06	0	7	32	0	10	12	0	12	45
68	0	2	40	0	5	20	0	8	00	0	10	41	0	13	38
69	0	2	47	0	5	34	0	8	21	0	11	80	0	14	55
70	0	2	55	0	5	50	0	8	45	0	11	40	0	14	35
71	0	3	04	0	6	09	0	9	13	0	12	18	0	15	22
72	0	3	14	0	6	28	0	9	42	0	12	56	0	16	11
73	0	3	25	0	6	50	0	10	15	0	13	41	0	17	05
74	0	3	38	0	7	15	0	10	53	0	14	30	0	18	08
75	0	3	52	0	7	44	0	11	36	0	15	23	0	19	20
76	0	4	08	0	8	16	0	12	24	0	16	32	0	20	40
77	0	4	27	0	8	54	0	13	21	0	17	48	0	22	15
78	0	4	48	0	9	37	0	14	25	0	19	24	0	24	02
79	0	5	14	0	10	29	0	15	45	0	20	58	0	26	12
80	0	5	45	0	11	31	0	17	16	0	23	02	0	28	47
81	0	6	21	0	12	47	0	19	10	0	25	14	0	32	57
82	0	7	11	0	14	22	0	21	33	0	28	44	0	37	56
83	0	8	12	0	16	25	0	24	37	0	33	50	0	43	02
84	0	9	34	0	19	08	0	28	42	0	38	16	0	47	50

A Table to reduce Miles of Easting, c

Depart.	6 Mile.			7 Miles.			8 Miles.			9 Miles.			10 Mile.			20 Mi		
	d.	m.	f.	d.	m.	f.	d.	m.	f.	d.	m.	f.	d.	m.	f.	d.	m.	f.
45	0	8	29	0	9	54	0	11	19	0	12	44	0	14	08	0	28	16
46	0	8	58	0	10	05	0	11	31	0	12	57	0	14	24	0	28	47
47	0	8	48	0	10	16	0	11	44	0	13	13	0	14	40	0	29	21
48	0	8	58	0	10	28	0	11	57	0	13	27	0	14	57	0	29	53
49	0	9	08	0	10	40	0	12	12	0	13	43	0	15	14	0	30	25
50	0	9	20	0	10	53	0	12	27	0	14	00	0	15	33	0	31	07
51	0	9	22	0	11	06	0	12	33	0	14	18	0	15	51	0	31	47
52	0	9	44	0	11	23	0	13	00	0	14	37	0	16	14	0	32	31
53	0	9	58	0	11	38	0	13	18	0	14	57	0	16	37	0	33	14
54	0	10	12	0	11	57	0	13	36	0	15	19	0	17	01	0	34	02
55	0	10	28	0	12	12	0	13	57	0	15	41	0	17	26	0	34	51
56	0	10	44	0	12	31	0	14	18	0	16	05	0	17	52	0	35	40
57	0	11	01	0	12	51	0	14	41	0	16	31	0	18	18	0	36	41
58	0	11	19	0	13	13	0	15	06	0	16	59	0	18	52	0	37	40
59	0	11	39	0	13	35	0	15	32	0	17	28	0	19	24	0	38	50
60	0	12	00	0	14	00	0	16	00	0	18	00	0	20	00	0	40	00
61	0	12	22	0	14	26	0	16	30	0	18	33	0	20	37	0	41	15
62	0	12	47	0	14	55	0	17	02	0	19	10	0	21	18	0	42	36
63	0	13	13	0	15	25	0	17	37	0	19	49	0	22	12	0	44	03
64	0	13	41	0	15	58	0	18	13	0	20	32	0	23	45	0	45	37

Westing into Degrees of Longitude.

65	0	14	12	0	16	24	0	18	35	0	21	18	0	23	40	0	47	09
66	0	14	45	0	17	11	0	19	40	0	22	08	0	24	35	0	49	10
67	0	15	18	0	17	51	0	20	24	0	22	57	0	25	35	0	51	10
68	0	16	01	0	18	41	0	21	27	0	23	56	0	26	42	0	53	24
69	0	16	43	0	19	29	0	22	16	0	25	01	0	27	54	0	55	45
70	0	17	30	0	20	25	0	23	20	0	26	13	0	29	14	0	59	28
71	0	18	26	0	21	31	0	24	36	0	27	39	0	30	44	1	01	28
72	0	19	25	0	22	39	0	25	52	0	29	06	0	32	21	1	04	44
73	0	20	31	0	23	56	0	27	22	0	30	47	0	34	13	1	08	24
74	0	21	46	0	25	23	0	29	00	0	32	38	0	36	16	1	12	28
75	0	23	11	0	27	04	0	30	56	0	34	48	0	38	40	1	17	20
76	0	24	48	0	28	56	0	33	04	0	37	12	0	40	20	1	20	40
77	0	26	42	0	31	09	0	35	34	0	39	03	0	42	30	1	25	03
78	0	28	50	0	33	34	0	38	18	0	43	16	0	48	04	1	30	08
79	0	31	26	0	36	41	0	41	56	0	47	10	0	52	24	1	44	48
80	0	34	32	0	40	18	0	46	04	0	51	48	0	57	34	1	55	08
81	0	38	20	0	44	44	0	51	06	0	57	32	1	03	54	2	07	48
82	0	43	06	0	50	17	0	57	28	1	04	39	1	21	50	2	43	40
83	0	49	14	0	57	27	1	05	40	1	13	51	1	22	04	2	44	08
84	0	57	24	1	06	58	1	16	32	1	28	06	1	35	40	3	18	30

A Table to reduce Miles of Easting, o

Parall.	30 Mil.			40 Mil.			50 Mil.			60 Mil.			70 Mil.			80 Mil.		
	d.	m.	f.	d.	m.	f.	d.	m.	f.	d.	m.	f.	d.	m.	f.	d.	m.	f.
0	0	30	0	0	40	0	0	50	0	1	0	0	1	10	0	1	20	0
1	0	30	0	0	40	0	0	50	0	1	0	1	1	10	1	1	20	1
2	0	30	1	0	40	1	0	50	1	1	0	2	1	10	2	1	20	3
3	0	30	2	0	40	2	0	50	3	1	0	3	1	10	4	1	20	5
4	0	30	3	0	40	4	0	50	5	1	0	5	1	10	6	1	20	7
5	0	30	5	0	40	7	0	50	8	1	0	10	1	10	11	1	20	13
6	0	30	7	0	40	9	0	50	11	1	0	14	1	10	16	1	21	18
7	0	30	9	0	40	11	0	50	16	1	0	19	1	10	21	1	21	24
8	0	30	13	0	40	18	0	50	22	1	0	27	1	10	31	1	22	35
9	0	30	17	0	41	23	0	50	28	1	0	34	1	10	40	1	22	45
10	0	30	22	0	41	30	0	51	37	1	0	45	1	10	51	1	23	59
11	0	30	28	0	41	37	0	50	46	1	0	55	1	11	05	1	24	14
12	0	30	34	0	42	45	0	50	56	1	1	07	1	11	19	1	25	30
13	0	30	40	0	42	53	0	51	05	1	1	20	1	11	33	1	25	46
14	0	30	47	0	43	01	0	51	14	1	1	35	1	11	50	1	26	06
15	0	30	55	0	43	13	0	51	28	1	1	50	1	12	09	1	26	27
16	0	31	03	0	43	24	0	51	46	1	2	07	1	12	28	1	26	49
17	0	31	13	0	43	37	0	52	01	1	2	26	1	12	50	1	27	14
18	0	31	21	0	43	49	0	52	16	1	2	43	1	13	11	1	27	38
19	0	31	33	0	44	04	0	52	34	1	3	05	1	13	36	1	28	07
20	0	31	44	0	44	19	0	52	53	1	3	27	1	14	01	1	28	37
21	0	31	55	0	44	34	0	53	12	1	3	51	1	14	29	1	29	08
22	0	32	08	0	44	51	0	53	33	1	4	16	1	14	59	1	29	41
23	0	32	21	0	45	09	0	53	56	1	4	43	1	15	30	1	30	17
24	0	32	35	0	45	27	0	54	19	1	5	12	1	16	03	1	30	55
	0	32	50	0	45	47	0	54	44	1	5	41	1	16	37	1	31	34

Westing into Degrees of Longitude.

25	0	33	06	0	44	08	0	55	10	1	6	12	1	17	14	1	28	18
26	0	33	22	0	44	30	0	55	37	1	6	44	1	17	51	1	28	58
27	0	33	39	0	44	53	0	56	05	1	7	20	1	18	33	1	29	47
28	0	33	56	0	45	16	0	56	33	1	7	55	1	19	14	1	30	34
29	0	34	18	0	45	44	0	57	30	1	8	36	1	20	02	1	31	23
30	0	34	39	0	46	11	0	57	47	1	9	17	1	20	49	1	32	23
31	0	34	58	0	46	38	0	58	18	1	9	58	1	21	37	1	33	18
32	0	35	22	0	47	10	0	58	57	1	10	45	1	22	32	1	34	20
33	0	35	46	0	47	41	0	59	37	1	11	42	1	23	37	1	35	33
34	0	36	11	0	48	15	1	00	19	1	12	23	1	24	26	1	36	11
35	0	36	37	0	49	50	1	01	02	1	13	14	1	25	26	1	37	40
36	0	37	05	0	49	27	1	01	48	1	14	10	1	26	38	1	38	53
37	0	37	34	0	50	05	1	02	37	1	15	8	1	27	59	1	40	11
38	0	38	04	0	50	45	1	03	27	1	16	8	1	28	49	1	41	31
39	0	38	36	0	51	28	1	04	20	1	17	12	1	30	04	1	42	56
40	0	39	09	0	52	13	1	5	16	1	18	19	1	31	22	1	44	2.
41	0	39	45	0	53	00	1	6	15	1	19	30	1	32	45	1	46	00
42	0	40	22	0	53	49	1	7	17	1	20	44	1	34	11	1	47	38
43	0	41	17	0	54	49	1	8	21	1	21	14	1	35	56	1	49	19
44	0	41	43	0	55	37	1	9	30	1	23	25	1	37	19	1	51	13
45	0	42	24	0	56	33	1	10	41	1	24	50	1	38	58	1	53	07
46	0	43	11	0	57	39	1	11	58	1	26	22	1	40	45	1	55	09
47	0	43	59	0	58	34	1	13	19	1	27	59	1	42	28	1	57	18
48	0	44	50	0	59	47	1	14	43	1	29	40	1	44	36	1	59	33
49	0	45	51	1	00	57	1	16	11	1	31	26	1	46	40	2	01	54
50	0	46	40	1	02	14	1	17	47	1	33	21	1	48	56	2	04	23
51	0	47	40	1	03	33	1	19	27	1	35	20	1	51	13	2	07	07
52	0	48	43	1	04	58	1	21	12	1	37	27	1	53	41	2	09	55

The Use of this Table for reducing Miles Easting or Westing into Degrees and Minutes of Longitude.

IF the Miles given be under ten, or consists of just tens, as 10, 20, 30, 40, &c.

Look the Latitude down along the left hand edge under Parall. and the Miles in the Head of the Table, and in the common Angle of meeting, are the Degrees, minutes and seconds of Longitude, answering to so much Easting or Westing in that Latitude: As

Admit a Ship sail fifty Miles East or West in the Parallel of fifty degrees of Latitude; how many degrees of Longitude doth it make?

Look fifty minutes on the Head of the Table, and running down the Column till you come against fifty Lat. you'll find 1 deg. 17 min. 47 sec.

But if the Miles Easting or Westing be a compound number above ten, then break it into its articulate numbers, or into such parts as may be found on the head of the Table: and therewith make several Entries, taking out the corresponding difference of Longitude, the sum of all which differences will be the whole difference of Longitude answering to the given Easting or Westing. As admit a Ship has made 75 miles Easting in the Parallel of 48 deg. 00 min. Lat.

	deg.	min.	sec.
70 Miles gives	1	44	35
5 gives	0	07	28
Their Sum	1	52	03

is the difference of Longitude answering to 75 minutes Easting in 40 degrees Lat.

Suppo

Suppose there be required the Degrees of Longitude answering to 145 miles, East or West in the Lat 42 deg. 20 min.

	deg.	min.	sec.
60 gives	1	34	11
60 gives	1	34	11
5 gives	0	06	44
The Difference	3	15	06

Admit I being 1500 Miles West from the Meridian of *London*, and in the Latitude 53 deg. 00 min, see an Eclipse of the Moon begin at 30 deg. after eight of the Clock at night, and would know what of the Clock it's then at *London*.

	deg	m.	sec.
60 miles gives	2	12	56
60 gives	2	56	19
So 150 miles gives	4	09	15
Which multiplied by 10, makes	41	32	30

	deg.	h.	m.	sec.
Then say	15	1	41	32½
	60		60	
	900		2492	
	2		2	
	1800		4985	
			1345	
			60	
			807.00	
			185	
			160	
			900	

The

The time at *London* 11 hours, 48 minutes, 10 sec.

h.	m.	sec.
2	44	10
8	30	00
11	14	50

Being to the Eastward of *London* in the Latitude of 53 degrees, see the beginning of an Eclipse at 14 min. 50 sec. after 11 of the clock at night: but the beginning happened at *London*, as I am inform'd, at 8 h. 30 min. how many miles am I to the Eastward of *London*?

	h.	m.	sec.
From	11	14	50
Substract	8	30	00
deg.	3	44	50

Then say if 1 h. 15 deg. 2 h. 44 min. 50 sec. and there comes 41 deg. 32 min. 30 sec. and looking in the Table against 53 deg. Lat. under 1 mile is 1 min. 40 sec. then again say 1 deg. 40 sec. 1 min. 41 deg. 32 min. 30 sec. and there comes 1496 miles, which ought to have been 1500, but 1 min. 40 sec. is too much by about half a second, which causes this difference.

Being in the Latitude 48 deg. and to the Westward of *London*, I saw exactly at 9 h. 40 min. 30 sec. after noon, the Moons Eastermost Limb or Edge just come up to *Aldibaran*, the time of the same appearance at *London*, I am informed, was at 11 h. 14 min. 50 sec. after noon, what was my difference of Longitude from *London*, and how many miles was I thence?

The hour of the night, 9 h. 40 min. 30 sec. was found by

by taking the heighth of the Star just at the instant of the Appulse.

	h.	m.	sec.
From	11	14	50
Take	9	40	30
Remainder	1	34	20

Say 1 h. 15 deg. 1 h. 34 min. 20 sec. and there comes 23 deg. 35 min. the Diff. of Longitude; then looking in the Table against 48 deg. Lat. under 1 mile is 1 min. 30 sec. then again say,
1 deg. 30 sec. 1 min. 23 deg. 35 min. and there comes 943 miles, the distance between the Ship and Meridian of *London*.

A Table.

A Table of Meridional Miles.

The Minutes of each Degree.

Deg. of Lat.	0	10	20	30	40	50	Difference.
	The Meridional Miles.						
0	0	10	20	30	40	50	10
1	60	70	80	90	100	110	10
2	120	130	140	150	160	170	10
3	180	190	200	210	220	230	10
4	240	250	260	270	280	290	10
5	300	310	320	330	340	350	10
6	360	370	380	390	400	410	10
7	421	431	441	451	461	471	10
8	481	491	501	511	521	532	10
9	542	552	563	572	582	592	10
10	603	613	623	633	643	653	10
11	664	674	684	694	704	715	10
12	725	735	745	755	766	776	10
13	786	797	807	817	827	838	10
14	848	858	869	879	889	900	10
15	910	920	930	941	951	962	10
16	972	983	993	1004	1014	1024	10
17	1035	1045	1056	1066	1077	1087	10
18	1098	1108	1119	1129	1140	1150	10
19	1161	1172	1182	1193	1203	1214	10
20	1225	1235	1246	1257	1267	1278	11
21	1289	1299	1310	1321	1331	1342	11
22	1353	1364	1375	1386	1396	1407	11
23	1418	1429	1440	1451	1462	1473	11
24	1484	1495	1505	1516	1527	1538	11
25	1549	1561	1572	1583	1594	1605	11
26	1616	1627	1638	1649	1661	1672	11
27	1683	1694	1705	1717	1728	1740	11
28	1751	1762	1774	1785	1796	1808	11
29	1819	1830	1842	1853	1865	1877	11

A Table of Meridional Miles.

Deg.	*The Minutes of each Degree.* 0	10	20	30	40	50	Difference.
	The Meridional Miles.						
30	1888	1899	1911	1923	1934	1946	12
31	1958	1969	1981	1993	2004	2016	12
32	2028	2040	2052	2063	2075	2087	12
33	2099	2111	2123	2135	2147	2159	12
34	2171	2183	2195	2207	2219	2231	12
35	2244	2256	2268	2281	2293	2305	12
36	2318	2330	2342	2355	2367	2380	12
37	2392	2405	2417	2430	2442	2455	12
38	2468	2481	2493	2506	2519	2532	13
39	2544	2557	2570	2583	2596	2609	13
40	2622	2635	2648	2662	2675	2688	13
41	2701	2714	2728	2741	2754	2768	13
42	2781	2795	2808	2822	2835	2849	13
43	2863	2876	2890	2904	2918	2932	14
44	2945	2959	2973	2987	3001	3015	14
45	3030	3044	3058	3072	3086	3101	14
46	3115	3130	3144	3159	3173	3188	14
47	3202	3217	3232	3247	3262	3276	15
48	3291	3306	3321	3336	3351	3366	15
49	3382	3397	3412	3428	3443	3459	15
50	3474	3490	3505	3521	3537	3553	16
51	3568	3584	3600	3616	3632	3649	16
52	3665	3681	3697	3714	3730	3747	16
53	3763	3780	3797	3814	3830	3847	17
54	3864	3881	3899	3915	3933	3950	17
55	3968	3985	4003	4020	4038	4056	18
56	4074	4092	4110	4128	4146	4164	19
57	4182	4201	4219	4238	4257	4275	19
58	4294	4313	4332	4351	4370	4390	20
59	4409	4428	4448	4468	4487	4507	20

A Table of Meridional Miles.

The Minutes of each Degree.

Deg. of Lat.	0	10	20	30	40	50	Difference.
	The Meridional Miles.						
60	4527	4547	4567	4586	4606	4626	20
61	4648	4670	4691	4711	4733	4754	21
62	4775	4796	4818	4839	4861	4883	22
63	4905	4927	4949	4972	4994	5017	23
64	5039	5062	5085	5108	5132	5155	23
65	5179	5203	5226	5250	5275	5299	24
66	5324	5348	5373	5398	5423	5449	25
67	5474	5500	5526	5552	5578	5604	26
68	5631	5658	5685	5712	5739	5767	27
69	5795	5823	5851	5879	5908	5937	28
70	5966	5996	6025	6055	6085	6115	30
71	6146	6177	6208	6239	6271	6303	31
72	6335	6368	6401	6434	6468	6501	33
73	6534	6570	6605	6640	6675	6711	35
74	6747	6783	6820	6857	6895	6933	37
75	6972	7010	7050	7089	7130	7172	40
76	7214	7258	7298	7338	7381	7424	41
77	7469	7513	7559	7605	7651	7698	46
78	7746	7795	7844	7894	7944	7996	50
79	8048	8100	8154	8209	8264	8320	55
80	8377	8435	8494	8555	8616	8678	60
81	8742	8806	8872	8939	9007	9077	68
82	9148	9218	9291	9371	9449	9528	77
83	9609	9691	9778	9865	9954	10046	88
84	10141	10238	10338	10441	10547	10656	109
85	10770	10887	11007	11133	11264	11398	128
86	11539	11686	11839	11999	12168	12344	165
87	12531	12718	12927	13150	13388	13644	230
88	13920	14221	14550	14914	15321	15783	376
89	16318	16930	17716	18729	20152	22625	

A Table of Proportional Parts.

D	1	2	3	4	5	6	7	8	9
10	1	2	3	4	5	6	7	8	9
11	1	2	3	4	5	7	8	9	10
12	1	2	4	5	6	7	8	10	11
13	1	3	4	5	7	8	9	10	12
14	1	3	4	6	7	8	10	11	13
15	1	3	4	6	7	9	10	12	13
16	2	3	5	6	8	10	11	13	14
17	2	3	5	7	8	10	12	14	15
18	2	4	5	7	9	11	12	14	16
19	2	4	6	8	9	11	13	15	17
20	2	4	6	8	10	12	14	16	18
21	2	4	6	8	10	13	15	17	19
22	2	4	7	9	11	13	15	18	20
23	2	5	7	9	11	14	16	18	21
24	2	5	7	10	12	14	17	19	22
25	2	5	7	10	13	15	17	20	22
26	3	5	8	10	13	15	18	21	23
27	3	5	8	11	13	16	19	22	24
28	3	6	8	11	14	17	20	22	25
29	3	6	9	12	15	18	21	24	27
30	3	7	10	13	16	20	23	26	30
35	4	7	11	14	17	21	24	28	31
37	4	7	11	15	18	22	26	30	33
40	5	8	12	16	20	24	28	32	36
55	5	11	16	22	27	33	38	44	49
60	6	12	18	24	30	36	42	48	54
68	6	13	20	27	34	40	47	54	61
77	7	15	23	30	38	46	53	61	69
83	8	17	26	35	44	52	61	70	79
105	10	21	31	42	52	63	73	84	94
128	12	25	38	51	64	76	89	102	115
167	16	33	49	66	82	99	115	132	148
230	23	46	69	92	115	138	161	184	207
	28		115	154	192	231	270	308	347

A Table of the Right Aſcenſions and De-
clinations of the moſt notable fixed Stars
for the year 1700, with their Differences
in a hundred years.

	Names of the Stars.	Right Aſcen. H.	M.	Decli-nation D.	M.	D.	D.
3	IN *Caſſiopeia*'s Breaſt.	0	24	54	55	6	34
2	The Pole Star.	0	39	27	43	16	14
2	The Southermoſt in the *whales* tail	0	29	12	38	5	34
2	*Andromeda*'s Girdle	0	53	34	05	53	
3	*Caſſiopeia*'s Knee	1	07	58	40	6	
3	The *whales* Belly.	1	37	11	45	5	
2	The South Foot of *Andromeda*	1	46	40	53	6	
3	The bright Star of *Aries*	1	51	22	03	6	
2	In the *whales* Chap	2	47	02	54	5	
3	*Medusa*'s Head	2	49	39	47	6	
2	*Perſeus* bright Side.	3	02	43	43	6	
3	The brighteſt of the *Pleiades*	3	30	23	10	6	
3	The North Eye of *Taurus*	4	11	18	31	6	

1 *Aldeb*

Names of the Stars.	Right Aſcen		Decli-natio.		D R	D. D.
	H.	M	D.	M.	m.	m.
Aldebran, or the South Eye of *Taurus*	4	19	15	53	6	15
The Goat *Capella*	4	55	45	40	7	10
The bright foot of *Orion Rigil*	5	01	8	33	5	9
The North Horn of *Taurus*	5	08	28	20	6	8
Orion's left Shoulder	5	09	6	0	5	8
1. In *Orion*'s Girdle	5	17	0	32	5	7
The Bull's South Horn	5	20	20	58	6	7
2. In *Orion*'s Girdle.	5	21	01	24	5	6
3. In *Orion*'s Girdle.	5	26	02	07	5	5
The right ſhoulder of *Aurigæ*	5	38	44	54	8	4
The bright foot of *Gemini*	6	20	16	38	6	2
The great Dog *Sirius*	6	32	16	15	5	4
The upper Head of *Gemini*	7	16	32	30	7	11
The leſſer Dog *Procyon*	7	24	6	00	5	12
The lower Head of *Gemini*	7	31	23	43	6	12
Hydra's Heart	9	13	7	22	5	25
The Lion's Heart *Baſiliſcus*	9	53	13	25	5	28
The lower Pointer	10	44	58	15	7	32
The middlemoſt in the Lion's Neck	10	00	21	11	6	29
The upper Pointer	10	46	63	38	7	32
The Lion's tail	11	24	16	15	5	34
The Root of the great Bear's tail	12	41	57	37	5	31
Virgin's Spike	13	10	09	33	5	32
The laſt but one in the great Bear's tail	13	12	56	31	4	32
The laſt in the great Bear's tail	13	36	50	51	4	31
Arcturus	14	02	20	42	5	29

	The Names of the Stars.	Right Ascen.	Decli.	
		H. M.	D. M	
2	The South balance	14 3	14 41	
2	The foremost Guard	14 51	7 16	
2	The North Balance.	15 04	8 74	
1	Bright Star of the Crown	15 22	27 41	
	The hindermost Guard	15 31	73 25	
2	The bright star in the serpent's Neck	15 30	7 25	
3	The left hand of *Ophiuchus*	15 59	2 11	
1	*Scorpio*'s heart, *Antares*	15 11	25 42	
3	*Hercules* right shoulder.	16 17	22 12	
3	The left knee of *Ophiuchus*	16 24	9 54	
3	The right knee of *Ophiuchus*	16 51	15 1-	
3	*Hercules* his head	17 01	14 47	
3	*Hercules* left shoulder	17 02	25 14	
3	The head of *Ophiuchus*	17 21	12 49	
3	The right shoulder of *Ophiuchus*	17 29	4 44	
3	The bright star in the Dragon's head	17 50	51 31	
1	*Lyra*	18 27	38 32	
3	The Vulture's tail.	18 28	23 28	
3	The Swan's beak	19 19	27 21	
2	The bright star of the Vulture	19 36	8 07	
3	The upper horn of *Capricorn*	20 01	13 24	
3	The lower horn of *Capricorn*	20 04	15 40	
3	The Swan's breast	20 12	39 17	
4	The left hand of *Aquarius*.	20 31	10 34	
2	The Swan's tail	20 31	44 14	
3	The Swan's lower wing	20 34	32 51	
3	The left shoulder of *Aquarius*	21 16	6 49	
3	The Girdle of *Cygnus*	21 25	69 15	

The Names of the Stars.	Right Ascen.		Declinario.		R. D. D	D. D. m.	
	H.	M	D.	M.	m.	m.	
Pegasus Mouth	21	30	8	31	5	26	
The bright shoulder of *Aquarius*	21	51	1	44	5	29	
Fomahant	22	41	31	08	6	31	
Scheat	22	49	26	28	5	32	
Markab	22	50	13	37	5	32	
Andromeda's Head.	23	53	27	28	5	34	

IF the right Ascension be less than six hours, or more than eighteen hours, the Declination of those stars that are to the North of the Equinoctial must be increased by the Difference for time to come, and the Southern stars Declinations decreased: but in the other Hemisphere where the Right Ascension is more than six hours, or less than eighteen hours, the contrary.

The Traverse Table for

	1 Deg.	1½ De.	1 Deg.	1½ De.	¼ De.	½ De.
dist	M. Par.	M. P.	M. P.	M. P.	M. P.	M. P.
1	1 00	57 60	1 00	87 10	1 01	11 41
2	2 00	144 60	2 00	58 20	2 02	22 82
3	3 00	171 00	3 00	57 30	3 03	34 23
4	4 01	229 20	4 01	76 40	4 04	45 64
5	5 00	286 50	5 01	95 50	5 05	57 05
6	6 00	343 80	6 01	114 60	6 06	68 46
7	7 00	401 10	7 01	133 70	7 07	79 87
8	8 00	458 40	8 01	152 80	8 08	91 28
9	9 00	515 70	9 01	171 90	9 09	102 69
10	10 00	573 00	10 01	191 00	10 10	114 10
20	20 00	1146 00	20 03	382 00	20 20	228 20
30	30 02	1719 00	30 04	573 00	30 31	342 30
40	40 01	2292 00	40 06	764 00	40 41	456 40
50	50 01	2865 00	50 07	955 00	50 51	570 50
60	60 01	3438 00	60 08	1146 00	60 61	684 60
70	70 01	4011 00	70 10	1337 00	70 71	798 70
80	80 01	4584 00	80 11	1528 00	80 81	912 80
90	90 01	5157 00	90 13	1719 00	90 91	1026 90
100	100 02	5730 00	100 14	1910 00	100 101	1141 00

	2 De.		3 De.		4 De.		5 De.		6 De.	
dif.	M.	p.	M.	p.	M.	p.	M.	p.	M.	p.
1	1	02	2	65	1	00	1	34	1	01
2	2	03	5	31	2	02	2	68	2	01
3	3	05	8	98	3	01	4	03	3	02
4	4	06	11	60	4	01	5	36	4	03
5	5	08	14	33	5	01	7	70	5	04
6	6	09	17	90	6	01	8	04	6	05
7	7	11	20	53	7	02	10	38	7	06
8	8	12	23	20	8	02	11	72	8	06
9	9	14	25	87	9	02	13	06	9	07
10	10	01	28	50	10	02	14	40	10	08
20	20	01	57	01	20	05	28	80	20	11
30	30	02	85	50	30	07	43	20	30	16
40	40	03	114	00	40	10	57	60	40	22
50	50	03	142	50	50	12	72	00	50	25
60	60	04	171	00	61	14	86	40	60	31
70	70	04	200	51	70	17	100	80	70	36
80	80	05	228	01	81	19	115	20	80	44
90	90	05	257	50	90	22	129	60	90	50
100	100	06	285	00	100	24	144	00	100	57

	7 De.		8 De.	
dif.	M.	p.	M.	p.
1	1	01	1	37
2	2	01	2	75
3	3	02	4	13
4	4	03	5	50
5	5	04	6	87
6	6	05	8	25
7	7	06	9	62
8	8	07	11	00
9	9	08	12	37
10	10	09	13	75
20	21	18	27	50
30	32	27	41	25
40	43	36	55	00
50	53	45	68	75
60	64	54	82	50
70	75	63	96	25
80	86	72	110	00
90	96	81	123	75
100	107	90	137	50

The Traverse Table for

	7 Deg.	8 Deg.	9 Deg.	10 Deg.	11 Deg.	12 Deg.
dist	M. Par.	M. P.	M. P.	M. P.	M. P.	M. P.
1	1 01	1 01	1 02	1 02	1 03	1 04
2	2 01	2 02	2 03	2 04	2 05	2 07
3	3 02	3 03	3 04	3 06	3 08	3 11
4	4 03	4 04	4 05	4 07	4 10	4 14
5	5 04	5 05	5 06	5 08	5 12	5 17
6	6 04	6 06	6 07	6 10	6 14	6 20
7	7 05	7 07	7 09	7 12	7 16	7 23
8	8 06	8 08	8 10	8 13	8 18	8 26
9	9 07	9 09	9 11	9 15	9 20	9 29
10	10 08	10 10	10 12	10 17	10 22	10 32
20	20 15	20 20	20 25	20 33	20 44	20 63
30	30 23	30 30	30 37	30 50	30 66	30 95
40	40 30	40 40	40 50	40 66	40 88	41 26
50	50 38	50 50	51 02	51 83	51 10	51 58
60	60 45	60 60	61 15	61 99	62 32	63 09
70	70 53	70 70	71 27	72 16	73 54	74 41
80	80 60	80 80	81 40	82 32	83 76	85 73
90	90 68	90 90	91 52	92 49	93 98	96 04
100	100 75	101 01	102 05	103 65	104 20	106 36

	8 Deg.		9 . De		10 De.		11 De.		12 De.		87 De	
	M	P.	M.	P.	M.	P.	M.	P.	M.	P.	M.	P.
1	1	01	7	13	1	02	5	70	1	03	4	71
2	2	02	14	37	2	03	11	33	2	04	9	62
3	3	03	21	10	3	05	17	28	3	07	14	43
4	4	04	28	74	4	06	23	04	4	09	19	24
5	5	05	35	52	5	08	28	80	5	11	24	05
6	6	06	42	11	6	09	34	55	6	13	28	86
7	7	07	48	30	7	11	40	31	7	16	33	67
8	8	08	55	48	8	12	46	07	8	18	38	47
9	9	09	62	67	9	14	51	83	9	20	43	28
10	10	10	71	85	10	15	57	59	10	22	48	09
20	20	20	143	70	20	31	115	18	20	45	96	19
30	30	29	215	56	30	46	172	76	30	67	144	28
40	40	39	287	41	40	62	230	35	40	89	192	37
50	50	49	359	27	50	77	287	93	51	12	240	47
60	61	59	431	12	60	93	345	51	61	14	288	56
70	71	69	502	97	71	08	403	10	71	36	336	66
80	81	79	574	82	81	24	460	70	81	58	384	75
90	91	89	646	68	91	39	518	28	92	01	432	84
100	102	98	718	53	101	54	575	88	102	23	480	94

The Traverse Table for

	11 De.		77 De.		15 De.		73 De.		17 De.		71 De.	
dl	M.	P.	M.	P.	M.	P.	M.	P.	M.	P.	M.	P.
1	1	02	4	45	1	04	1	56	1	05	1	41
2	2	05	8	89	2	07	7	71	2	09	6	82
3	3	08	14	34	3	11	11	56	3	14	10	15
4	4	10	17	78	4	14	15	41	4	18	13	68
5	5	13	22	23	5	18	19	32	5	23	17	10
6	6	16	26	66	6	21	23	18	6	27	20	51
7	7	18	31	12	7	25	27	03	7	32	23	99
8	8	21	35	56	8	28	30	91	8	37	27	36
9	9	24	40	00	9	32	34	77	9	41	30	78
10	10	26	42	45	10	35	38	64	10	46	34	40
20	20	53	88	91	20	71	77	28	20	91	68	41
30	30	79	133	26	31	06	115	91	31	37	102	61
40	41	05	177	82	41	41	154	55	41	83	136	81
50	51	32	222	87	51	76	193	18	52	28	171	21
60	61	58	266	72	62	12	231	82	62	74	205	22
70	71	84	311	18	72	47	270	46	73	20	239	62
80	82	10	355	63	82	82	309	10	83	66	273	02
90	92	37	400	09	93	18	347	73	94	11	307	83
100	102	63	444	54	103	53	386	37	104	57	342	03

the

	14 De.		76 De.		16 De.		74 De.		18 De.		72 De.	
	M.	p.	M.	p.	M.	p.	M.	p.	M.	p.	M.	p.
1	1	03	4	13	1	04	3	63	1	05	3	24
2	2	06	8	26	2	08	7	26	2	10	6	47
3	3	09	12	40	3	12	10	88	3	15	9	71
4	4	12	16	51	4	16	14	51	4	21	13	94
5	5	15	20	67	5	20	18	14	5	26	16	18
6	6	11	24	83	6	24	21	77	6	31	19	42
7	7	21	28	94	7	28	25	40	7	36	22	65
8	8	24	33	07	8	31	29	02	8	41	25	89
9	9	28	37	20	9	36	32	65	9	46	29	12
10	10	31	41	33	10	40	36	28	10	51	32	36
20	20	61	82	67	20	80	72	56	21	03	65	73
30	30	92	124	01	31	21	108	84	31	54	97	08
40	41	22	165	34	41	61	145	12	42	06	129	44
50	51	53	206	68	52	01	181	40	52	57	161	80
60	61	84	248	01	62	42	217	68	63	09	194	16
70	72	14	289	35	72	82	253	96	73	60	226	52
80	82	45	330	69	83	22	290	24	84	12	258	89
90	92	76	372	02	93	63	326	52	94	02	291	25
100	103	08	413	36	104	03	362	80	105	15	323	61

The Traverse Table for

	19 De.		71 De.		21 De.		69 De.		23 De.		61 De.	
dif.	M.	P.	M.	P.	M.	P.	M.	P.	M.	P.	M.	P.
1	1	06	3	07	1	07	3	72	1	09	2	56
2	2	11	6	14	2	14	5	58	2	17	5	12
3	3	17	9	21	3	21	8	37	3	26	7	68
4	4	23	12	29	4	28	11	16	4	35	10	24
5	5	29	15	36	5	36	13	95	5	43	12	81
6	6	35	18	43	6	43	16	74	6	52	15	37
7	7	40	21	50	7	50	19	53	7	60	17	93
8	8	46	24	57	8	57	22	31	8	69	20	49
9	9	52	27	64	9	64	25	11	9	78	23	05
10	10	58	30	72	10	72	27	90	10	86	25	50
20	21	15	61	43	21	43	55	81	21	73	51	12
30	31	73	92	15	32	15	83	71	32	59	76	74
40	42	30	122	86	42	86	111	62	43	45	102	37
50	52	88	153	58	53	56	139	52	54	32	127	99
60	63	46	184	29	64	27	167	43	65	18	153	58
70	74	03	215	01	74	98	195	33	76	05	179	17
80	84	61	245	72	85	69	223	24	86	91	204	74
90	95	19	276	44	96	40	251	14	97	77	230	31
100	105	76	307	16	107	11	279	04	108	64	255	91

	22 De.		72 De.		12 De.		68 De.		24 De.		66 De.	
M.	M.	P.	M.	P.	M.	P.	M.	P.	M.	P.	M.	P.
1	1	06	3	93	1	08	3	67	1	09	2	45
2	2	13	5	85	2	16	5	34	2	19	4	92
3	3	19	8	77	3	24	8	01	3	28	7	38
4	4	26	11	70	4	32	10	68	4	38	9	85
5	5	32	14	62	5	39	13	35	5	47	12	29
6	6	39	17	54	6	47	16	02	6	57	14	75
7	7	45	20	47	7	55	18	69	7	66	17	21
8	8	51	23	39	8	63	21	36	8	76	19	67
9	9	58	26	31	9	71	24	03	9	85	22	13
10	10	64	29	24	10	79	26	70	10	95	24	59
20	21	29	58	47	21	57	53	40	21	89	49	17
30	31	93	87	70	32	36	80	08	32	84	73	76
40	42	57	116	94	43	14	106	75	43	78	98	34
50	53	21	146	18	53	93	133	47	54	73	122	93
60	63	85	175	41	64	71	160	17	65	68	147	52
70	74	49	204	65	75	50	186	86	76	62	172	10
80	85	13	233	90	86	28	213	56	87	57	196	69
90	95	78	263	14	97	07	240	21	98	51	221	27
100	106	42	292	38	107	85	266	95	109	46	245	86

The

The Traverse Table for

dif.	25 De. M.	p.	65 De. M.	p.	27 De. M.	p.	63 De. M.	p.	29 De. M.	p.	61 De. M.	p.
1	1	10	2	37	1	12	2	20	1	14	2	06
2	2	41	4	74	2	24	4	40	2	29	4	11
3	3	31	7	10	3	37	6	61	3	43	6	19
4	4	41	9	47	4	49	8	81	4	57	8	25
5	5	52	11	83	5	61	11	01	5	72	10	31
6	6	62	14	20	6	73	13	22	6	86	12	37
7	7	72	16	56	7	86	15	42	8	00	14	44
8	8	83	18	93	8	98	17	62	9	15	16	50
9	9	93	21	30	10	10	19	82	10	29	18	50
10	11	03	23	66	11	22	22	03	11	43	20	63
20	22	07	47	32	22	45	44	05	22	87	41	25
30	33	10	70	97	33	67	66	08	34	30	61	88
40	44	14	94	63	44	89	88	11	45	73	82	51
50	55	17	118	31	56	12	110	14	57	17	103	13
60	66	20	141	97	67	34	132	16	68	60	123	76
70	77	24	165	63	78	56	154	19	80	03	144	39
80	88	27	189	30	89	79	176	22	91	47	165	01
90	99	30	212	96	101	01	198	24	102	90	185	64
100	110	34	236	62	112	23	220	27	114	34	206	27

the

	26 De.		64 De		28 De.		62 De.		30 De.		60 De.	
dC	M.	P.	M.	P.	M.	P.	M.	P.	M.	P.	M.	P.
1	1	11	2	28	1	13	2	13	1	15	2	00
2	2	23	4	56	2	27	4	26	2	31	4	00
3	3	34	6	84	3	40	6	39	3	46	6	00
4	4	45	9	12	4	53	8	52	4	62	8	00
5	5	56	11	41	5	66	10	65	5	77	10	00
6	6	68	13	69	6	80	12	78	6	93	12	00
7	7	79	15	97	7	93	14	91	8	08	14	00
8	8	90	18	25	8	06	17	04	9	24	16	00
9	10	01	20	53	10	19	19	17	10	39	18	00
10	11	13	22	81	11	33	21	30	11	55	20	00
20	22	25	45	62	22	65	42	60	23	09	40	00
30	33	38	68	44	33	98	63	90	34	64	60	00
40	44	50	91	25	45	30	85	20	46	19	80	00
50	55	63	114	06	56	63	106	50	57	73	100	00
60	66	76	136	87	67	95	127	80	69	29	120	00
70	77	88	159	68	70	28	149	10	80	83	140	00
80	89	01	182	49	90	61	170	40	92	38	160	00
90	100	13	205	31	101	93	191	70	103	92	180	00
100	111	26	228	12	113	26	213	00	115	47	200	00

The Traverse Table for

dif.	31 De. M.	P.	9 De. M.	P.	33 De. M.	P.	57 De. M.	P.	35 De. M.	P.	55 De. M.	P.	dif.
1	1	17	1	94	1	19	1	84	1	22	1	74	1
2	2	33	3	88	2	38	3	67	2	44	3	47	2
3	3	50	5	82	3	58	5	51	3	66	5	21	3
4	4	67	7	77	4	77	7	14	4	88	6	95	4
5	5	83	9	71	5	96	9	18	6	10	8	72	5
6	7	00	11	65	7	15	11	02	7	32	10	46	6
7	8	17	13	59	8	35	12	85	8	55	12	21	7
8	9	33	15	54	9	54	14	69	9	77	13	97	8
9	10	50	17	47	10	73	16	52	10	99	15	73	9
10	11	67	19	42	11	92	18	36	12	21	17	49	10
20	23	33	38	83	21	85	36	72	24	42	34	97	20
30	35	00	58	25	32	77	55	08	36	62	52	22	30
40	46	67	77	66	43	70	73	44	48	83	69	74	40
50	58	33	97	08	54	62	91	80	61	04	87	23	50
60	70	00	116	50	65	54	110	17	73	25	104	81	60
70	81	66	135	91	83	47	128	53	85	46	122	04	70
80	93	32	155	33	95	39	146	89	97	66	139	48	80
90	105	00	174	74	107	32	165	25	109	87	156	91	90
100	116	66	194	16	119	24	183	61	122	08	174	35	100

	32 De.		38 De.		34 De.		36 De.		54 De.	
Dif.	M.	p	M.	p.	M.	p.	M.	2.	M.	p.
1	1	18	1	89	1	21	1	79	1	24	1	70
2	2	36	3	77	2	41	3	58	2	47	3	40
3	3	54	5	66	3	62	5	36	3	71	5	10
4	4	72	7	55	4	82	7	15	4	94	6	80
5	5	90	9	44	6	03	8	94	6	18	8	51
6	7	08	11	33	7	24	10	73	7	42	10	21
7	8	21	13	21	8	44	12	52	8	65	11	91
8	9	43	15	10	9	65	14	31	9	89	13	61
9	10	61	16	98	10	86	16	09	11	13	15	31
10	11	79	18	87	12	05	17	88	12	36	17	02
20	23	58	37	74	24	12	35	77	24	72	34	03
30	35	38	56	61	36	19	53	65	37	08	51	04
40	47	17	75	48	48	25	71	53	49	45	68	05
50	58	96	94	35	60	31	89	42	61	80	85	06
60	70	75	113	22	72	37	107	30	74	17	102	08
70	82	54	132	10	84	43	125	18	86	53	119	09
80	94	33	150	97	96	50	143	05	98	89	136	10
90	106	13	169	84	108	56	160	95	111	25	153	12
100	117	93	188	71	120	62	178	83	123	61	170	13

The

The Traverse Table for

	37 De.		53 De.		39 De.		51 De.		41 De.		49 De.	
dif.	M.	p.	M.	p.	M.	p.	M.	p.	M.	p.	M.	p.
1	1	25	1	66	1	29	1	59	1	32	1	52
2	2	50	3	32	2	57	3	18	2	65	3	03
3	3	76	4	98	3	86	4	77	3	97	4	55
4	5	01	6	65	5	15	6	36	5	30	6	10
5	6	26	8	31	6	43	7	95	6	62	7	62
6	7	51	9	97	7	72	9	10	7	95	9	11
7	8	76	11	63	9	01	11	12	9	27	10	67
8	10	02	13	29	10	29	12	71	10	60	12	13
9	11	27	14	95	11	58	14	30	11	92	13	72
10	12	52	16	62	12	87	15	89	13	45	15	24
20	25	04	33	23	25	73	31	78	26	50	30	48
30	37	56	49	85	38	60	47	67	39	75	45	73
40	50	09	66	47	51	47	63	56	52	00	60	97
50	62	61	83	08	64	34	79	45	66	25	76	21
60	75	13	99	70	77	21	95	34	78	50	91	46
70	87	65	116	31	90	08	111	23	92	75	106	70
80	100	17	132	93	102	94	127	12	106	00	121	94
90	112	70	149	55	115	81	143	01	119	25	137	19
100	125	22	166	16	128	63	158	90	132	50	152	43

the

	38 De.		39 De.		40 De.		50 De.		42 De.		48 De.	
	M.	p.	M.	p.	M.	p.	M.	p.	M.	p.	M.	p.
1	1	37	1	62	1	31	1	56	1	31	1	49
2	2	54	3	85	2	61	3	11	2	69	2	97
3	3	81	4	87	3	92	4	67	4	04	4	48
4	5	08	6	30	5	22	6	22	5	38	5	98
5	6	34	8	12	6	53	7	78	6	73	7	47
6	7	61	9	75	7	83	9	33	8	07	8	97
7	8	88	11	37	9	14	10	89	9	42	10	46
8	10	15	12	99	10	44	12	45	10	76	11	96
9	11	42	14	62	11	75	14	00	12	11	13	45
10	12	69	16	24	13	05	15	56	13	46	14	44
10	25	38	32	49	26	11	31	11	26	91	29	89
20	38	07	48	73	39	16	46	67	40	37	44	83
30	50	76	64	97	52	22	62	23	53	83	59	78
40	63	45	81	21	65	27	77	78	67	21	74	72
52	76	14	97	46	78	32	93	34	80	74	89	67
72	89	83	113	70	91	38	108	90	94	19	104	61
89	101	52	129	94	104	43	124	46	107	65	119	56
90	114	21	146	19	117	49	140	01	121	11	134	50
100	126	90	162	43	130	54	155	57	134	56		

A Table for the true Chart

dif.	43 De. M.	p.	47 De. M.	p.	44 De. M.	p.	46 De. M.	p.	45 De. M.	p.
1	1	37	1	47	1	39	1	41	1	41
2	2	75	2	94	2	78	2	82	2	83
3	4	10	4	40	4	17	4	22	4	23
4	5	47	5	87	5	56	5	63	5	66
5	6	84	7	33	6	95	7	20	8	07
6	8	20	8	80	8	34	8	64	8	49
7	9	57	10	26	9	73	10	04	9	90
8	10	94	11	73	11	12	11	52	11	31
9	12	31	13	20	12	61	12	96	12	73
10	13	67	14	96	13	90	14	40	14	14
20	27	35	29	33	27	80	28	79	28	28
30	41	02	43	99	41	78	43	19	42	43
40	54	69	58	65	55	61	57	58	56	57
50	68	37	73	31	69	51	71	98	70	71
60	82	04	87	98	83	41	86	38	84	85
70	95	71	102	84	97	31	100	77	98	99
80	109	39	117	30	111	22	115	17	113	14
90	123	06	131	96	125	12	129	56	127	8
100	136	73	146	63	139	02	143	96	141	42

A Table

A Table of the Sun's Right Ascension.

Janu.		Febr.		March.		April.		May.		June.	
H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	A	M.
19	35	21	44	23	28	1	21	3	14	5	20
19	38	21	48	23	32	1	25	3	18	5	24
19	42	21	52	23	36	1	29	3	22	5	28
19	47	21	54	23	39	1	32	3	26	5	32
19	51	21	58	23	43	1	36	3	30	5	36
19	56	22	02	23	47	1	40	3	34	5	40
20	00	22	06	23	50	1	43	3	38	5	44
20	05	22	10	23	54	1	47	3	42	5	49
20	09	22	14	23	58	1	51	3	46	5	53
20	13	22	17	0	01	1	54	3	50	5	57
20	17	22	21	0	05	1	58	3	54	6	01
20	21	22	25	0	08	2	02	3	58	6	05
20	25	22	29	0	12	2	06	4	02	6	09
20	30	22	33	0	16	2	09	4	06	6	14
20	34	22	36	0	19	2	13	4	10	6	18
20	38	22	40	0	23	2	17	4	14	6	22
20	42	22	44	0	27	2	21	4	18	6	26
20	46	22	48	0	30	2	24	4	22	6	30
20	50	22	51	0	34	2	28	4	26	6	34
20	54	22	55	0	38	2	32	4	30	6	38
20	59	22	59	0	41	2	36	4	34	6	42
21	03	23	01	0	45	2	40	4	38	6	47
21	07	23	06	0	48	2	44	4	43	6	51
21	11	23	10	0	52	2	47	4	47	6	55
21	15	23	14	0	56	2	51	4	51	6	59
21	19	23	17	0	59	2	55	4	55	7	03
21	23	23	21	1	03	2	59	4	59	7	07
21	27	23	25	1	05	3	03	5	03	7	11
21	31			1	10	3	07	5	07	7	15
21	35			1	14	3	10	5	11	7	20
21	39			1	17			5	15		

A Table of the Sun's Right Aſcenſion.

Day.	July. H.	M.	August H.	M.	Sept. H	M.	Octob. H.	M.	Nov. H.	M.	Dec. H.	M.
1	7	24	9	26	11	19	13	05	15	08	17	16
2	7	28	9	29	11	23	13	12	15	12	17	21
3	7	33	9	33	11	26	13	16	15	16	17	25
4	7	36	9	37	11	30	13	19	15	21	17	30
5	7	40	9	41	11	34	13	23	15	25	17	34
6	7	44	9	44	11	38	13	27	15	29	17	38
7	7	48	9	48	11	41	13	31	15	33	17	41
8	7	52	9	52	11	45	13	34	15	37	17	47
9	7	56	9	56	11	48	13	38	15	41	17	52
10	8	00	9	59	11	52	13	42	15	45	17	56
11	8	04	10	03	11	55	13	46	15	50	18	01
12	8	08	10	07	11	59	13	49	15	54	18	05
13	8	12	10	10	12	03	13	53	15	58	18	10
14	8	16	10	14	12	06	13	57	16	02	18	14
15	8	20	10	18	12	10	14	01	16	06	18	18
16	8	24	10	22	12	14	14	05	16	11	18	22
17	8	28	10	25	12	17	14	09	16	15	18	27
18	8	32	10	29	12	21	14	13	16	19	18	32
19	8	36	10	33	12	24	14	16	16	24	18	36
20	8	40	10	36	12	28	14	20	16	28	18	41
21	8	43	10	40	12	31	14	24	16	32	18	45
22	8	47	10	43	12	35	14	28	16	37	18	49
23	8	51	10	47	12	39	14	32	16	41	18	54
24	8	55	10	51	12	43	14	36	16	45	18	57
25	8	59	10	54	12	46	14	40	16	50	19	01
26	9	03	10	58	12	50	14	44	16	54	19	07
27	9	06	11	02	12	54	14	48	16	59	19	11
28	9	10	11	05	12	57	14	52	17	03	19	16
29	9	14	11	09	13	01	14	56	17	07	19	20
30	9	18	11	12	13	04	15	00	17	12	19	24
31	9	22	11	16			15	04			19	29

The

Sun's Declination 1681, 1685, 1689, 1693.

Jan. South.		Febr. South.		March. South		April. North.		May. North.		June. North	
D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.
21	41	13	42	1	20	8	49	16	7	23	11
21	38	13	22	2	56	9	02	16	2	23	15
21	21	13	02	2	32	9	23	16	37	23	18
21	10	12	41	2	09	9	45	15	51	23	21
20	58	12	21	1	45	10	05	15	06	23	24
20	47	11	59	1	21	10	27	14	19	23	26
20	34	11	36	0	59	10	48	13	31	23	27
20	22	11	17	0	34	11	09	13	46	23	29
20	09	10	55	0	10	11	30	13	59	23	30
19	56	10	31	Nor	14	11	50	12	11	23	30
19	42	10	12	0	37	12	11	12	23	23	30
19	28	9	50	1	01	12	31	12	35	23	30
19	14	9	28	1	24	12	50	12	46	23	29
18	59	9	05	1	48	13	10	12	57	23	27
18	44	8	43	2	11	13	30	13	08	23	26
18	29	8	21	2	35	13	49	13	18	23	24
18	13	7	58	2	58	14	05	13	28	23	21
17	57	7	36	3	22	14	27	13	38	23	18
17	41	7	13	3	45	14	45	13	47	23	15
17	24	6	50	4	04	15	03	13	56	23	11
17	07	6	27	4	31	15	21	14	04	23	07
16	50	6	04	4	54	15	39	14	12	23	03
16	32	5	40	5	17	15	57	14	20	22	58
16	14	5	17	5	40	16	14	14	27	22	53
15	56	4	54	6	13	16	31	14	34	22	47
15	38	4	30	6	26	16	48	14	41	22	41
15	20	4	07	6	49	17	04	14	47	22	34
15	00	3	43	7	11	17	21	14	53	22	27
14	41			7	33	17	37	14	58	22	20
14	22			7	55	17	52	15	03	22	12
14	02			8	18			15	07		

The

The first Year after Leap-Year.

The Sun's Declination 1681, 1685, 1689, 169

Day of the Month	July. North. D.	M.	August North. D.	M.	Sept. North. D.	M.	Octob. South. D.	M.	Nov. South. D.	M.	Dec. South. D.	M.
1	22	4	15	6	4	17	7	21	17	43	21	
2	22	56	14	48	3	54	7	54	17	59	21	
3	21	47	14	30	3	31	8	6	18	15	21	
4	21	38	14	12	3	8	8	29	18	31	21	
5	21	28	13	54	2	45	8	51	18	47	22	
6	21	18	13	35	2	21	9	13	19	4	22	
7	21	8	13	16	1	58	9	34	19	20	23	
8	20	58	12	56	1	35	9	56	19	36	23	
9	20	47	12	35	1	11	10	19	19	52	23	
10	20	35	12	15	0	48	10	40	19	57	23	
11	20	24	11	55	0	24	11	2	20	20	23	
12	20	12	11	35	0	01	11	23	20	2	23	
13	19	59	11	14	Sept. 22		11	49	20	36	23	
14	19	47	10	53	0	46	12	5	20	48	23	
15	19	34	10	32	1	09	12	26	20	59	23	
16	19	20	10	11	1	33	12	46	21	11	23	
17	19	7	9	51	1	56	13	7	21	21	23	
18	18	53	9	29	2	20	13	27	21	32	23	
19	18	38	9	7	2	44	13	47	21	42	23	
20	18	24	8	46	3	07	14	7	21	51	21	
21	18	9	8	24	3	30	14	26	22	1	23	
22	17	54	8	2	3	54	14	45	22	9	23	
23	17	38	7	40	4	17	15	4	22	18	23	
24	17	22	7	18	4	40	15	23	22	26	23	
25	17	6	6	56	5	1	15	41	22	33	23	
26	16	50	6	34	5	27	16	0	22	40	23	
27	16	33	6	11	5	50	16	18	22	47	22	
28	16	16	5	48	6	12	16	35	22	54	22	
29	15	59	5	26	6	36	16	51	22	58	22	
30	15	42	5	3	6	58	17	10	23	03	22	
31	15	24	4	40			17	27			22	

The Sun's Declination 1682, 1686, 1690, 1694

Jan. South		Feb. South		March. South		April. North		May. North		June. North	
D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.
21	43	13	47	3	26	8	39	18	4	23	11
21	34	13	27	3	02	8	55	18	19	23	14
21	23	13	7	2	38	9	18	18	34	23	18
21	12	12	46	2	15	9	40	18	48	23	21
21	1	12	25	1	51	10	01	19	01	23	23
20	49	12	5	1	27	10	22	19	16	23	25
20	37	11	43	1	02	10	42	19	29	23	27
20	25	11	22	0	40	11	4	19	43	23	28
20	12	11	01	0	16	11	25	19	55	23	29
19	59	10	39	North	4	11	45	20	8	23	30
19	45	10	17	0	31	12	6	20	20	23	30
19	31	9	55	0	55	12	26	20	32	23	30
19	18	9	34	1	19	12	46	20	44	23	29
19	3	9	11	1	42	13	5	20	55	23	28
18	48	8	49	2	05	13	25	21	5	23	27
18	33	8	26	2	29	13	44	21	16	23	24
18	17	8	4	2	53	14	3	21	26	23	22
18	1	7	41	3	16	14	22	21	36	23	19
17	45	7	18	3	39	14	41	21	45	23	16
17	28	6	55	4	03	14	59	21	54	23	13
17	11	6	32	4	26	15	17	22	2	23	8
16	54	6	9	4	49	15	35	22	10	23	4
16	37	5	46	5	12	15	53	22	18	22	59
16	19	5	23	5	35	16	10	22	26	22	54
16	1	4	59	5	58	16	27	22	33	22	48
15	42	4	36	6	21	16	44	22	39	22	42
15	24	4	12	6	43	17	0	22	45	22	36
15	5	3	49	7	5	17	17	22	51	22	29
14	46			7	28	17	33	22	57	22	22
14	27			7	50	17	48	23	2	22	14
14	7			8	12			23	6		

The

The second Year after Leap-Year.

The Sun's Declination 1682, 1686, 1690, 169

Days	July. North. D.	M.	August North. D.	M.	Sept. North. D.	M.	Octob. South. D.	M.	Nov. South. D.	M.	Dec. South. D.	M.
1	22	0	18	11	4	24	7	15	17	39	24	7
2	21	58	17	53	4	0	7	55	17	55	23	11
3	21	47	17	34	3	37	8	1	18	12	23	15
4	21	43	17	16	3	14	8	23	18	27	23	19
5	21	21	16	57	2	50	8	45	18	42	22	23
6	21	21	16	38	2	27	9	8	18	58	22	46
7	21	11	16	19	2	04	9	30	19	13	22	27
8	21	0	15	59	1	40	9	52	19	28	22	31
9	20	49	15	39	1	17	10	15	19	43	22	35
10	20	38	15	20	0	53	10	37	19	56	22	39
11	20	27	15	0	0	30	10	57	20	7	23	40
12	20	14	14	40	0	7	11	16	20	20	23	40
13	20	2	14	19	South 0	17	11	39	20	31	23	49
14	19	50	13	58	0	40	12	0	20	45	23	58
15	19	37	13	38	1	04	12	21	20	57	24	1
16	19	23	13	17	1	27	12	41	21	8	24	3
17	19	10	12	56	1	51	13	2	21	19	24	5
18	18	56	12	34	2	14	13	22	21	29	24	8
19	18	42	12	13	2	38	13	42	21	39	24	10
20	18	27	11	51	3	01	14	2	21	49	24	10
21	18	13	11	29	3	25	14	21	21	58	24	9
22	17	57	11	8	3	48	14	41	22	7	24	8
23	17	42	10	46	4	11	15	0	22	16	24	6
24	17	26	10	24	4	34	15	18	22	24	24	4
25	17	10	10	01	4	57	15	37	22	31	24	1
26	16	54	9	39	5	21	15	55	22	38	23	58
27	16	37	9	17	5	44	16	13	22	45	23	54
28	16	21	8	54	6	7	16	31	22	51	23	49
29	16	03	8	31	6	30	17	19	22	57	23	44
30	15	45	8	8	6	53	17	6	23	2	23	40
31	15	28	7	46			17	23			23	35

The

The Sun's Declination 1683, 1687, 1691, 1695

Jan. South.		Febr. South.		March. South		April North.		May. North.		June. North.	
D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.
21	46	13	52	1	31	8	29	18	0	23	10
21	36	13	31	1	8	8	51	18	15	23	12
21	26	13	11	2	44	9	13	18	30	23	17
21	15	12	51	3	20	9	39	18	44	23	20
21	03	12	31	4	57	9	56	18	59	23	23
20	52	12	10	5	31	10	17	19	13	23	25
20	40	11	49	6	9	10	38	19	26	23	27
20	28	11	28	6	45	10	59	19	42	23	28
20	15	11	6	7	22	11	20	19	58	23	29
20	2	10	44	Nor.	02	11	40	20	5	23	30
19	49	10	23	0	26	12	1	20	17	23	30
19	35	10	1	0	49	12	21	20	29	23	30
19	21	9	39	1	13	12	41	20	41	23	29
19	7	9	17	1	36	13	0	20	52	23	28
18	52	8	54	2	00	13	20	21	03	23	27
18	36	8	32	2	23	13	40	21	13	23	25
18	21	8	9	2	47	13	59	21	24	23	23
18	5	7	48	3	10	14	18	21	35	23	20
17	49	7	24	3	34	14	36	21	43	23	17
17	33	7	01	3	57	14	55	21	52	23	13
17	17	6	38	4	21	15	13	22	0	23	9
16	58	6	15	4	45	15	31	22	8	23	5
16	41	5	52	5	08	15	48	22	16	23	0
16	23	5	28	5	29	16	6	22	24	22	55
16	5	5	5	5	51	16	23	22	31	22	50
15	47	4	42	6	15	16	40	22	38	22	44
15	28	4	18	6	37	16	56	22	44	22	37
15	10	3	55	7	0	17	13	22	50	22	31
14	50			7	23	17	29	22	55	22	24
14	31			7	45	17	44	23	0	22	8
14	12			8	07			23	5		

The third Year after Leap-Year.

The Sun's Declination 1683, 1687, 1691, 1695

Days	July. North. D.	M.	August North. D.	M.	Sept. North. D.	M.	Octob. South. D.	M.	Nov. South. D.	M.	Dec. South. D.	M.
1	22	8	15	15	4	28	7	20	17	35	23	0
2	22	0	14	57	4	5	7	31	17	58	23	11
3	21	51	14	39	3	42	17	55	18	3	23	15
4	21	43	14	20	3	19	8	18	18	23	23	19
5	21	33	14	01	2	56	8	40	18	19	23	21
6	21	23	13	43	2	33	9	2	18	34	23	24
7	21	13	13	23	2	9	9	24	19	9	23	27
8	21	2	13	4	1	46	9	47	19	23	23	29
9	20	52	12	44	1	23	10	8	19	37	23	30
10	20	41	12	24	0	59	10	30	19	51	23	30
11	20	29	12	5	0	36	10	51	20	4	23	30
12	20	18	11	44	0	12	11	13	20	17	23	30
13	20	5	11	24	Sou.	11	11	34	20	30	23	27
14	19	53	11	3	0	35	11	55	20	42	23	26
15	19	40	10	41	0	58	12	16	20	54	23	24
16	19	27	10	21	1	22	12	36	21	5	23	20
17	19	13	10	01	1	45	12	57	21	16	23	17
18	19	0	9	41	2	9	13	17	21	27	23	15
19	18	45	9	18	2	32	13	37	21	37	23	11
20	18	31	8	56	2	55	13	57	21	47	23	8
21	18	16	8	35	3	19	14	17	21	56	23	7
22	18	1	8	13	3	42	14	36	22	5	22	2
23	17	46	7	51	4	6	14	55	22	14	22	57
24	17	30	7	29	4	29	15	14	22	22	22	51
25	17	14	7	7	4	52	15	32	22	29	22	46
26	16	58	6	44	5	15	15	51	22	37	22	39
27	16	42	6	22	5	38	16	9	22	43	22	33
28	16	25	5	59	6	2	16	27	22	50	22	27
29	16	8	5	37	6	24	16	44	22	56	22	19
30	15	50	5	14	6	47	17	2	23	1	22	12
31	15	33	4	51			17	19			22	4

The Sun's Declination 1684, 1688, 1692, 1696.

Day of the Month	Jan. South. D.	Jan. South. M.	Febr. South. D.	Febr. South. M.	March. South D.	March. South M.	April. North D.	April. North M.	May. North D.	May. North M.	June North D.	June North M.
1	22	48	13	37	3	13	8	43	16	0	23	12
2	21	38	13	27	2	50	9	7	16	27	23	16
3	21	28	13	17	2	26	9	29	16	41	23	19
4	21	18	12	56	2	2	9	51	16	55	23	22
5	21	7	12	36	1	39	10	12	17	9	23	24
6	20	57	12	15	1	15	10	33	17	23	23	26
7	20	46	11	54	0	51	10	54	17	37	23	28
8	20	34	11	32	0	28	11	15	17	49	23	29
9	20	23	11	11	0	4	11	35	18	2	23	30
10	20	11	10	50	Nor. 0	19	11	56	18	14	23	30
11	19	58	10	28	0	43	12	16	18	27	23	30
12	19	46	10	6	1	7	12	36	18	38	23	29
13	19	34	9	44	1	30	12	56	18	49	23	28
14	19	22	9	22	1	54	13	15	19	0	23	27
15	19	10	9	0	2	18	13	35	19	11	23	25
16	18	58	8	37	2	41	13	54	19	21	23	23
17	18	46	8	15	3	05	14	13	19	31	23	20
18	18	34	7	52	3	28	14	32	19	40	23	17
19	18	21	7	29	3	51	14	50	19	49	23	14
20	18	9	7	7	4	14	15	8	19	58	23	10
21	17	56	6	44	4	38	15	26	20	7	23	6
22	17	43	6	21	5	1	15	44	20	14	23	1
23	17	31	5	57	5	24	16	2	20	22	22	56
24	17	17	5	34	5	47	16	19	20	29	22	51
25	17	10	5	11	6	9	16	36	20	36	22	45
26	16	58	4	47	6	32	16	52	20	43	22	39
27	16	33	4	24	6	55	17	9	20	49	22	32
28	16	14	4	1	7	17	17	25	20	54	22	24
29	16	55	3	37	7	39	17	41	20	59	22	18
30	16	36			8	02	17	56	21	04	22	10
31	16	16			8	24			21	9		

The Leap-Year.

The Sun's Declination 1684, 1688, 1692, 1696.

Days	July. North. D.	M.	August North. D.	M.	Sept. North. D.	M.	Octob. South. D.	M.	Nov. South. D.	M.	Dec. South. D.	M.
1	22	2	15	1	4	11	7	27	17	45	23	
2	21	54	14	43	3	48	7	50	18	4	23	
3	21	45	14	21	3	25	8	12	18	20	23	
4	21	31	14	6	3	02	8	35	18	35	23	
5	21	16	13	47	2	38	8	57	18	50	23	
6	21	10	13	28	2	15	9	18	19	5	23	
7	21	05	13	9	1	51	9	41	19	20	23	
8	20	55	12	49	1	28	10	1	19	34	23	
9	20	44	12	29	1	5	10	25	19	47	23	
10	20	32	12	10	0	41	10	46	20	01	23	
11	20	21	11	49	0	18	11	8	20	14	23	
12	20	08	11	29	0	6	11	29	20	27	23	
13	19	56	11	8	Sou.	29	11	50	20	39	23	
14	19	43	10	48	0	51	12	11	20	51	23	
15	19	30	10	27	1	16	12	32	21	2	23	
16	19	17	10	6	1	40	12	52	21	13	23	
17	19	03	9	45	2	03	13	12	21	24	23	
18	18	49	9	24	2	27	13	32	21	35	23	
19	18	34	9	2	2	50	13	52	21	44	23	
20	18	20	8	40	3	13	14	12	21	54	23	
21	18	05	8	18	3	37	14	31	22	3	23	
22	17	50	7	56	4	0	14	50	22	12	23	
23	17	34	7	34	4	23	15	9	22	20	23	
24	17	18	7	12	4	47	15	28	22	28	23	
25	17	02	6	50	5	10	15	47	22	35	23	
26	16	46	6	27	5	33	16	5	22	42	23	
27	16	29	6	5	5	56	16	23	22	48	23	
28	16	12	5	42	6	19	16	41	22	54	23	
29	15	55	5	20	6	41	16	58	23	0	23	
30	15	37	4	57	7	05	17	15	23	5	23	
31	15	20	4	34			17	31			23	

The Use of these Tables of the Sun's Declination.

LOok the Year on the Head of the Table, and the Month under it; and the Day down along the Left and Colum, and right against the Day in the Column appropriated to the Month, you have the Sun's Declination for that Day at Noon under the Meridian of *London*.

EXAMPLE.

To find the Sun's Declination the 25th of *July* at Noon, in 1684.

Turn over the Table till you find the Year 1684, then look downwards under the Month *July*, till against the 25th day, and there you'll find 17 deg. 2 min. Declinat. South.

But if you be to the Eastward or Westward of the Meridian of *London*, you must make an allowance in the Sun's Declination, according to the following little Table

A Table to Reduce the Sun's Declination to any other Meridian.

Daily Diff. of Declinat.	m. 0	m. 3	m. 6	m. 9	m. 12	m. 15	m. 18	m. 21	m. 24
	m.	m.	m.	m.	m.	m.	m.	m.	m.
	15	0	0	0	0	0	1	1	1
	30	0	0	0	0	1	1	2	2
	45	0	0	0	1	1	2	3	3
Degrees	60	0	0	1	1	2	2	3	4
of Long.	75	0	0	1	2	2	3	4	5
either	90	0	0	1	2	3	4	5	6
East or	105	0	1	2	2	3	4	6	7
West.	120	0	1	2	3	4	5	7	8
	135	0	1	2	3	4	5	8	9
	150	0	1	2	3	5	6	9	10
	165	0	1	2	4	5	6	8	10	11
	180	0	1	3	4	6	7	9	11	12

If the Difference of Longitude be Westerly, and the Declination increasing, the number found in this little Table must be added to the Declination found; but if the Declination be decreasing, it must be substracted therefrom; and the contrary.

Admit the 25th of *June*, 1684, you desire to know the Sun's Declination at 105 degr. Longitude East from *London*.

The Declination for the 25th of *July* in the Meridian

f London is 17 deg. 02 min. and the daily difference
t that time is 16 min. Which 16 min, looked in the
ead of the Table, cannot be found but under the near-
ft thereto, viz. 15 min, and right against 105 deg. you'll
ind 4 min. which muſt be added to 17 deg. 0 min.
nd the ſum 17 deg. 06 min. is the true Declination
here at Noon; but if it had been 105 deg. Weſt Long.
he Declination would have been but 16 deg. 58 min.

A Table of Amplitudes.

Deg.	4		6		8		10		12		14		16	
	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.
1	1	0	1	0	1	0	1	1	1	1	1	1	1	1
2	2	0	2	0	2	1	2	2	2	2	2	2	2	2
3	3	0	3	1	3	1	3	3	3	3	3	4	3	4
4	4	1	4	2	4	2	4	3	4	5	4	5	4	5
5	5	1	5	2	5	3	5	4	5	6	5	7	5	7
6	6	1	6	3	6	4	6	5	6	7	6	8	6	9
7	7	1	7	3	7	5	7	6	7	8	7	9	7	10
8	8	1	8	3	8	5	8	7	8	9	8	11	8	12
9	9	1	9	3	9	5	9	7	9	10	9	12	9	13
10	10	1	10	3	10	6	10	8	10	11	10	13	10	14
11	11	1	11	4	11	6	11	9	11	12	11	14	11	15
12	12	1	12	4	12	7	12	10	12	13	12	15	12	16
13	13	2	13	4	13	7	13	11	13	14	13	16	13	17
14	14	2	14	5	14	8	14	12	14	15	14	17	14	18
15	15	2	15	5	15	9	15	13	15	16	15	18	15	19
16	16	2	16	5	16	10	16	14	16	17	16	19	16	20
17	17	3	17	6	17	10	17	15	17	18	17	20	17	21
18	18	3	18	6	18	11	18	16	18	19	18	21	18	22
19	19	3	19	6	19	12	19	17	19	20	19	22	19	23
20	20	3	20	7	20	12	20	18	20	21	20	23	20	24
21	21	3	21	7	21	13	21	19	21	22	21	24	21	25
22	22	4	22	8	22	13	22	20	22	23	22	25	22	26
23	23	4	23	9	23	14	23	21	23	24	23	26	23	27
24	24	4	24	9	24	15	24	22	24	25	24	27	24	28
25	25	5	25	10	25	15	25	23	25	26	25	28	25	29
26	26	5	26	10	26	16	26	24	26	27	26	29	26	30
27	27	6	27	11	27	17	27	25	27	28	27	30	27	31
28	28	6	28	11	28	18	28	26	28	29	28	31	28	32
29	29	6	29	12	29	18	29	27	29	30	29	32	29	33
30	30	7	30	12	30	19	30	28	30	31	30	33	30	34

	18		20		21		22		23		24		25	
	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.
1	1	3	1	4	1	4	1	5	1	5	1	6	1	6
2	2	5	2	7	2	7	2	8	2	9	2	10	2	11
3	3	8	3	10	3	11	3	12	3	14	3	15	3	17
4	4	14	4	17	4	19	4	21	4	23	4	25	4	27
5	5	16	5	19	5	21	5	24	5	26	5	28	5	31
6	6	19	6	24	6	26	6	29	6	32	6	35	6	38
7	7	22	7	26	7	29	7	33	7	36	7	40	7	44
8	8	24	8	31	8	34	8	38	8	42	8	46	8	50
9	9	26	9	35	9	39	9	43	9	47	9	51	9	56
10	10	28	10	38	10	43	10	48	10	53	10	58	11	02
11	11	31	11	39	11	43	11	48	11	54	12	00	12	08
12	12	38	12	47	12	52	12	57	13	01	13	09	13	16
13	13	41	13	51	13	57	14	03	14	09	14	17	14	23
14	14	45	14	55	15	01	15	08	15	15	15	22	15	29
15	15	48	16	00	16	07	16	14	16	21	16	28	16	37
16	16	51	17	03	17	12	17	17	17	25	17	33	17	42
17	17	54	18	7	18	15	18	21	18	31	18	40	18	49
18	18	58	19	11	19	20	19	29	19	38	19	47	19	56
19	20	00	20	16	20	24	20	33	20	43	20	53	21	03
20	21	04	21	21	21	30	21	39	21	49	21	59	22	10
21	22	10	22	28	22	37	22	46	22	56	23	06	23	17
22	23	11	23	30	23	40	23	50	24	01	24	13	24	25
23	24	13	24	34	24	46	24	56	25	8	25	21	25	33
24	24	48	25	06	25	18	25	29	25	41	25	54	26	08
25	25	22	25	38	25	50	26	01	26	14	26	27	26	42
26	26	24	26	43	26	55	27	07	27	19	27	34	27	47
27	27	28	27	48	28	00	28	14	28	26	28	43	28	55
28	28	33	28	53	29	6	29	20	29	32	29	50	30	04
29	29	35	29	58	30	11	30	27	30	40	30	57	31	12
30	30	39	31	03	31	18	31	34	31	48	31	04	32	20
31	31	45	32	8	32	24	32	40	32	56	33	12	33	29

A Table of Amplitudes.

Deg.	26		27		28		29		30		31		32	
	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.
1	1	7	1	7	1	8	1	8	1	09	1	10	1	11
2	2	13	2	14	2	15	2	16	2	17	2	19	2	21
3	3	19	3	21	3	22	3	24	3	25	3	28	3	31
4	4	25	4	28	4	29	4	32	4	34	4	37	4	41
5	5	31	5	35	5	37	5	40	5	42	5	46	5	51
6	6	38	6	42	6	44	6	48	6	51	6	55	7	01
7	7	44	7	49	7	52	8	00	8	03	8	08	8	12
8	8	50	9	00	9	05	9	08	9	12	9	17	9	22
9	10	01	10	06	10	12	10	16	10	20	10	26	10	32
10	11	07	11	13	11	20	11	24	11	29	11	35	11	42
11	12	16	12	24	12	30	12	37	12	40	12	51	13	03
12	13	21	13	30	13	37	13	44	13	53	14	02	14	13
13	14	29	14	37	14	45	14	53	15	02	15	11	15	23
14	15	37	15	46	15	55	16	04	16	13	16	24	16	35
15	16	44	16	55	17	04	17	13	17	23	17	34	17	46
16	17	51	18	04	18	14	18	22	18	33	18	45	18	58
17	18	59	19	13	19	24	19	32	19	44	19	57	20	10
18	20	07	20	23	20	34	20	42	20	54	21	08	21	22
19	21	14	21	32	21	44	21	51	22	04	22	19	22	34
20	22	22	22	41	22	54	23	01	23	14	23	30	23	47
21	23	28	23	49	24	03	24	10	24	24	24	41	24	59
22	24	36	24	58	25	13	25	22	25	35	25	52	26	11
23	25	43	26	07	26	23	26	32	26	45	27	03	27	23
23½	26	21	26	32	26	51	27	00	27	14	27	33	27	53
24	26	46	27	12	27	18	27	44	27	56	28	14	28	34
25	28	04	28	21	28	39	28	57	29	15	29	35	29	56
26	29	15	29	33	29	50	30	07	30	25	30	45	31	08
27	30	22	30	42	31	00	31	18	31	37	31	58	32	21
28	31	31	31	50	32	09	32	29	32	50	33	13	33	37
29	32	40	33	01	33	21	33	42	34	04	34	27	34	53
30	33	49	34	10	34	32	34	54	35	16	35	41	36	08

A Table of Amplitudes.

	33		34		35		36		37		38		39	
	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.
1	1	22	1	22	1	23	1	24	1	25	1	26	1	27
2	2	23	2	25	2	26	2	28	2	30	2	32	2	34
3	3	34	3	37	3	40	3	43	3	45	3	48	3	51
4	4	45	4	50	4	53	4	57	5	00	5	04	5	08
5	5	56	6	02	6	06	6	11	6	16	6	21	6	26
6	7	11	7	15	7	20	7	25	7	31	7	37	7	44
7	8	20	8	25	8	33	8	40	8	47	8	54	9	01
8	9	33	9	40	9	47	9	54	10	02	10	10	10	19
9	10	45	10	51	11	01	11	09	11	18	11	27	11	37
10	11	58	12	06	12	15	12	24	12	33	12	43	12	54
11	13	06	13	17	13	27	13	38	13	49	14	01	14	13
12	14	18	14	32	14	42	14	53	15	05	15	18	15	31
13	15	31	15	44	15	56	16	09	16	22	16	35	16	49
14	16	46	16	58	17	11	17	24	17	38	17	53	18	08
15	17	59	18	11	18	25	18	40	18	55	19	10	19	26
16	19	11	19	25	19	40	19	55	20	11	20	28	20	45
17	20	24	20	39	20	55	21	11	21	28	21	46	22	04
18	21	37	21	53	22	10	22	27	22	48	23	05	23	24
19	22	50	23	07	23	25	23	44	24	01	24	24	24	44
20	24	04	24	22	24	41	25	00	25	21	25	43	26	04
21	25	19	25	37	25	57	26	18	26	39	27	03	27	27
22	26	32	26	52	27	13	27	35	26	58	28	23	28	49
23	27	46	28	07	28	29	28	53	29	17	29	43	30	11
24	28	34	28	45	29	07	29	32	29	57	30	23	30	53
25	29	01	29	21	29	40	30	11	30	37	31	06	31	35
26	30	16	30	39	31	04	31	30	31	57	32	27	32	58
27	31	31	31	55	32	21	32	48	33	17	33	48	34	20
28	32	47	33	12	33	39	34	08	34	37	35	09	35	42
29	34	03	34	30	34	58	35	28	35	58	36	31	37	06
30	35	19	35	47	36	18	36	49	37	21	37	54	38	30

A Table of Amplitudes.

Sun's Dec.	40		41		42		43		44		45		46	
	d.	m.	d.	m.	d.	m.	d.	m.	d.	m.	d.	m.	d.	m.
1														
2		18	1	19	1	20	1	21	1	23	1	25	1	26
3	2	37	2	37	2	42	2	44	2	47	2	50	2	51
4	3	55	3	56	4	02	4	06	4	11	4	15	4	19
5	5	13	5	17	5	22	5	28	5	34	5	40	5	46
6	6	32	6	38	6	44	6	51	6	58	7	05	7	12
7	7	51	7	58	8	06	8	13	8	21	8	30	8	37
8	9	09	9	17	9	26	9	35	9	45	9	55	10	04
9	10	28	10	37	10	47	10	57	11	08	11	20	11	31
10	11	47	11	57	12	09	12	20	12	33	12	47	13	01
11	13	06	13	18	13	31	13	44	13	58	14	14	14	31
12	14	26	14	38	14	53	15	07	15	23	15	40	15	57
13	15	45	15	59	16	15	16	31	16	48	17	06	17	24
14	17	05	17	20	17	37	17	55	18	14	18	33	18	52
15	18	25	18	42	19	00	19	19	19	39	19	59	20	21
16	19	45	20	03	20	23	20	44	21	05	21	27	21	51
17	21	05	21	25	21	46	22	08	22	32	22	56	23	23
18	22	26	22	47	23	10	23	34	23	59	24	25	24	53
19	23	48	24	10	24	34	25	00	25	27	25	54	26	25
20	25	09	25	33	25	59	26	26	26	54	27	24	27	57
21	26	31	26	57	27	24	27	51	28	22	28	53	29	30
22	27	53	28	20	28	49	29	20	29	51	30	23	31	03
23	29	17	29	45	30	16	30	49	31	21	31	53	32	38
24	30	40	31	10	31	43	32	17	32	51	33	24	34	14
25	32	04	32	35	33	10	33	45	34	21	34	56	35	50
26	33	28	33	59	34	37	35	14	35	52	36	29	37	27
27	34	52	35	24	36	04	36	43	37	23	38	03	39	04
28	36	16	36	49	37	31	38	13	38	54	39	37	40	42
29	37	41	38	14	38	59	39	43	40	26	41	12	42	21
30	39	06	39	40	40	27	41	13	41	58	42	47	43	59
31	40	31	41	05	41	56	42	43	43	31	44	22	45	38
32	41	56	42	31	43	25	44	13	45	03	45	57	47	17

A Table of Amplitudes.

	47		48		49		50		51		52		53	
Sun's Decl.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.
1	0	27	0	29	0	31	0	33	0	35	0	37	0	39
2	0	54	0	58	1	01	1	07	1	10	1	15	1	19
3	1	21	1	27	1	34	1	40	1	46	1	53	1	59
4	1	48	1	56	2	06	2	14	2	22	2	31	2	39
5	2	15	2	25	2	38	2	48	2	58	3	09	3	20
6	2	42	2	54	3	09	3	21	3	33	3	47	4	00
7	3	09	3	23	3	41	3	56	4	10	4	26	4	41
8	3	36	3	52	4	12	4	31	4	47	5	04	5	22
9	4	03	4	21	4	43	5	05	5	24	5	44	6	04
10	4	30	4	50	5	15	5	40	6	01	6	23	6	46
11	4	56	5	19	5	46	6	14	6	39	7	03	7	29
12	5	23	5	48	6	18	6	48	7	17	7	43	8	11
13	5	50	6	17	6	49	7	22	7	55	8	23	8	53
14	6	16	6	46	7	21	7	56	8	33	9	03	9	35
15	6	43	7	15	7	53	8	30	9	11	9	43	10	17
16	7	09	7	44	8	24	9	04	9	49	10	23	10	59
17	7	36	8	13	8	56	9	38	10	27	11	03	11	41
18	8	03	8	42	9	28	10	12	11	05	11	43	12	23
19	8	29	9	10	9	59	10	46	11	43	12	23	13	05
20	8	56	9	39	10	31	11	20	12	21	13	03	13	47
21	9	22	10	07	11	03	11	54	12	59	13	43	14	29
22	9	48	10	35	11	35	12	28	13	37	14	23	15	11
23	10	14	11	03	12	07	13	02	14	15	15	03	15	53
24	10	40	11	31	12	39	13	36	14	53	15	43	16	35
25	11	06	11	59	13	11	14	10	15	31	16	23	17	17
26	11	32	12	27	13	43	14	44	16	09	17	03	17	59
27	11	58	12	55	14	15	15	18	16	47	17	43	18	41
28	12	24	13	23	14	47	15	52	17	25	18	23	19	23
29	12	50	13	51	15	19	16	26	18	03	19	03	20	05
30	13	16	14	19	15	51	17	00	18	41	19	43	20	47
31	13	41	14	47	16	23	17	34	19	19	20	23	21	29
32	14	07	15	15	16	55	18	08	19	57	21	03	22	11
33	14	32	15	43	17	27	18	42	20	35	21	43	22	53
34	14	58	16	11	17	59	19	16	21	13	22	23	23	35
35	15	23	16	39	18	31	19	50	21	51	23	03	24	17
36	15	48	17	07	19	03	20	24	22	29	23	43	24	59
37	16	13	17	35	19	35	20	58	23	07	24	23	25	41
38	16	38	18	03	20	07	21	32	23	45	25	03	26	23
39	17	03	18	31	20	39	22	06	24	23	25	43	27	05
40	17	28	18	59	21	11	22	40	25	01	26	23	27	47
41	17	53	19	27	21	43	23	14	25	39	27	03	28	29
42	18	18	19	55	22	15	23	48	26	17	27	43	29	11
43	18	43	20	23	22	47	24	22	26	55	28	23	29	53
44	19	08	20	51	23	19	24	56	27	33	29	03	30	35
45	19	33	21	19	23	51	25	30	28	11	29	43	31	17
46	19	58	21	47	24	23	26	04	28	49	30	23	31	59
47	20	23	22	15	24	55	26	38	29	27	31	03	32	41
48	20	48	22	43	25	27	27	12	30	05	31	43	33	23
49	21	13	23	11	25	59	27	46	30	43	32	23	34	05
50	21	38	23	39	26	31	28	20	31	21	33	03	34	47
51	22	03	24	07	27	03	28	54	31	59	33	43	35	29
52	22	28	24	35	27	35	29	28	32	37	34	23	36	11
53	22	53	25	03	28	07	30	02	33	15	35	03	36	53

A Table of Amplitudes.

Sun's Dec.	54 D.	54 M.	55 D.	55 M.	56 D.	56 M.	57 D.	57 M.	58 D.	58 M.	59 D.	59 M.	60 D.	60 M.
1	0	42	0	45	0	47	0	50	0	53	0	56	1	0
2	1	24	1	29	1	33	1	41	1	47	1	53	2	6
3	2	06	2	14	2	22	2	31	2	40	2	50	3	0
4	2	49	2	59	3	10	3	22	3	34	3	47	4	1
5	3	31	3	44	3	57	4	12	4	28	4	43	5	2
6	4	14	4	30	4	46	5	03	5	22	5	42	6	4
7	4	58	5	15	5	35	5	56	6	17	6	41	7	06
8	5	41	6	01	6	24	6	48	7	14	7	40	8	10
9	6	25	6	46	7	13	7	42	8	10	8	40	9	14
10	7	11	7	32	8	03	8	36	9	08	9	42	10	18
11	7	56	8	19	8	54	9	29	10	06	10	44	11	23
12	8	41	9	05	9	44	10	24	11	05	11	46	12	28
13	9	27	9	52	10	35	11	20	12	04	12	48	13	34
14	10	13	10	39	11	27	12	16	13	03	13	50	14	40
15	10	58	11	27	12	18	13	12	14	02	14	52	15	46
16	11	44	12	14	13	10	14	08	15	01	15	54	16	52
17	12	29	13	02	14	02	15	04	16	00	16	56	17	58
18	13	15	13	50	14	54	15	59	16	59	17	58	19	04
19	14	01	14	38	15	46	16	55	17	58	19	00	20	10
20	14	46	15	27	16	38	17	51	18	57	20	02	21	16
21	15	32	16	15	17	31	18	47	19	56	21	04	22	22
22	16	18	17	04	18	23	19	43	20	55	22	06	23	28
23	17	04	17	52	19	16	20	40	21	54	23	08	24	34
24	17	50	18	41	20	08	21	36	22	53	24	10	25	40
25	18	36	19	30	21	01	22	33	23	52	25	12	26	46
26	19	22	20	19	21	54	23	30	24	51	26	14	27	52
27	20	08	21	08	22	47	24	27	25	50	27	16	28	58
28	20	54	21	57	23	40	25	24	26	49	28	18	30	04
29	21	40	22	46	24	33	26	21	27	48	29	20	31	10
30	22	26	23	35	25	26	27	18	28	47	30	22	32	16
31	23	12	24	24	26	19	28	15	29	46	31	24	33	22
32	23	58	25	13	27	12	29	12	30	45	32	26	34	28
33	24	44	26	02	28	05	30	09	31	44	33	28	35	34
34	25	30	26	51	28	58	31	06	32	43	34	30	36	40
35	26	16	27	40	29	51	32	03	33	42	35	32	37	46
36	27	02	28	29	30	44	33	00	34	41	36	34	38	52
37	27	48	29	18	31	37	33	57	35	40	37	36	39	58
38	28	34	30	07	32	30	34	54	36	39	38	38	41	04
39	29	20	30	56	33	23	35	51	37	38	39	40	42	10
40	30	06	31	45	34	16	36	48	38	37	40	42	43	16
41	30	52	32	34	35	09	37	45	39	36	41	44	44	22
42	31	38	33	23	36	02	38	42	40	35	42	46	45	28
43	32	24	34	12	36	55	39	39	41	34	43	48	46	34
44	33	10	35	01	37	48	40	36	42	33	44	50	47	40
45	33	56	35	50	38	41	41	33	43	32	45	52	48	46
46	34	42	36	39	39	34	42	30	44	31	46	54	49	52
47	35	28	37	28	40	27	43	27	45	30	47	56	50	58
48	36	14	38	17	41	20	44	24	46	29	48	58	52	04
49	37	00	39	06	42	13	45	21	47	28	50	00	53	10
50	37	46	39	55	43	06	46	18	48	27	51	02	54	16
51	38	32	40	44	43	59	47	15	49	26	52	04	55	22
52	39	18	41	33	44	52	48	12	50	25	53	06	56	28
53	40	04	42	22	45	45	49	09	51	24	54	08	57	34
54	40	50	43	11	46	38	50	06	52	23	55	10	58	40
55	41	36	44	00	47	31	51	03	53	22	56	12	59	46
56	42	22	44	49	48	24	52	00	54	21	57	14	60	52
57	43	08	45	38	49	17	52	57	55	20	58	16	61	58
58	43	54	46	27	50	10	53	54	56	19	59	18	63	04
59	44	40	47	16	51	03	54	51	57	18	60	20	64	10
60	45	26	48	05	51	56	55	48	58	17	61	22	65	16

A Table of Refractions.

A. D.	Refra. M.	Se.
0	30	00
1	25	15
2	18	30
3	14	00
4	11	00
5	9	30
6	7	30
7	6	30
8	5	45
9	5	00
10	4	30
11	4	15
12	4	00
13	3	45
14	3	30
15	3	15
16	3	00
17	2	45
18	2	30
19	2	15
20	2	00
21	2	00
22	1	45
23	1	45
24	1	30
25	1	30
26	1	30
27	1	15
28	1	15
29	1	15
30	1	00

The Use of this Table of Refractions.

Look the Altitude of the Sun or Star in the first Column, under A. and right against it in the other Column you have the Minutes and Seconds refracted, which you must substract from the Alt. found by Observation.

A Table of the Sun's Rising and Setting.

North Latitude.

Dec. °	Lat.	5	10	15	20	25	30	35	40
Sun's		H.M	H.M	H.M	H.M	H.M	H.M	H.M	H.M
11		5 51	5 48	5 35	5 24	5 13	5 2	4 49	4 34
17		5 51	5 42	5 33	5 24	5 12	5 3	4 50	4 35
23		5 52	5 41	5 33	5 25	5 14	5 4	4 51	4 36
28		5 53	5 43	5 34	5 25	5 16	5 6	4 53	4 37
3		5 53	5 44	5 35	5 27	5 18	5 8	4 56	4 44
9		5 53	5 45	5 37	5 29	5 21	5 11	5 00	4 48
15		5 54	5 46	5 39	5 31	5 23	5 15	5 04	4 54
21		5 54	5 48	5 41	5 33	5 26	5 19	5 10	5 08
27		5 55	5 49	5 43	5 36	5 30	5 21	5 15	5 06
2		5 56	5 52	5 47	5 43	5 38	5 33	5 28	5 22
8		5 57	5 53	5 49	5 45	5 42	5 38	5 34	5 31
14		5 58	5 55	5 52	5 49	5 47	5 44	5 41	5 36
20		5 58	5 57	5 55	5 52	5 50	5 49	5 47	5 44
26		5 59	5 58	5 57	5 56	5 55	5 54	5 53	5 52
4		6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0
10		6 1	6 2	6 3	6 4	6 5	6 6	6 7	6 8
16		6 2	6 3	6 5	6 7	6 9	6 11	6 13	6 16
22		6 2	6 5	6 8	6 11	6 13	6 16	6 19	6 24
28		6 3	6 7	6 11	6 15	6 18	6 22	6 25	7 32
1		6 4	6 8	6 13	6 17	6 22	6 27	6 32	6 39
9		6 4	6 10	6 15	6 21	6 26	6 31	6 37	6 47
15		6 5	6 11	6 17	6 24	6 30	6 37	6 45	6 54
22		6 6	6 12	6 19	6 27	6 34	6 41	6 50	7 0
28		6 6	6 14	6 21	6 29	6 37	6 45	6 56	7 6
5		6 7	6 15	6 23	6 31	6 39	6 49	7 0	7 12
10		6 7	6 16	6 25	6 33	6 42	6 52	7 4	7 17
17		6 8	6 17	6 26	6 35	6 44	6 54	7 7	7 21
23		6 8	6 17	6 27	6 35	6 46	6 56	7 9	7 24
29		6 9	6 18	6 27	6 36	6 47	6 57	7 10	7 25
4		6 9	6 18	6 27	6 36	6 47	6 58	7 11	7 26
11									
Sun's Dec.		H.M	H.M	H.M	H.M	H.M	H.M	H.M	H.M
	Lat.	Lat.	10	15	20	25	30	35	40

South Latitude.

A Table of the Sun's Rising and Setting.

North Latitude.

46	47	50	52	54	56	58	60	d.	L.
m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	S.	R.
21	4 09	3 55	3 45	3 33	3 20	3 4	2 44	11	11
25	4 13	3 56	3 46	3 34	3 21	3 5	2 46	1	17
29	4 18	3 59	3 49	3 37	3 24	3 9	2 51	29	23
33	4 16	4 01	3 53	3 43	3 30	3 16	2 59	27	30
37	4 21	4 09	4 00	3 50	3 38	3 25	3 09	25	6
37	4 27	4 10	4 02	3 58	3 48	3 36	3 22	23	12
43	4 34	4 14	4 09	4 08	3 59	3 48	3 35	21	19
49	4 42	4 23	4 16	4 19	4 11	4 01	3 50	19	25
53	4 54	4 43	4 27	4 30	4 23	4 15	4 05	17	31
00	5 09	4 53	4 48	4 41	4 36	4 31	4 21	15	6
13	5 10	5 04	5 00	4 55	4 50	4 44	4 37	13	13
41	5 19	5 15	5 11	5 08	5 04	4 59	4 54	11	19
33	5 29	5 26	5 23	5 21	5 18	5 14	5 16	9	25
42	5 43	5 37	5 36	5 34	5 31	5 29	5 27	7	31
51	5 50	5 49	5 48	5 47	5 46	5 49	5 48	5	6
00	6 00	6 00	6 00	6 00	6 00	6 00	6 00	3	12
09	6 10	6 11	6 12	6 13	6 14	6 15	6 17	1	18
18	6 20	6 23	6 24	6 26	6 28	6 31	6 33	29	25
27	6 34	6 31	6 37	6 39	6 42	6 46	6 50	27	31
36	6 41	6 49	6 49	6 52	6 56	7 01	7 06	25	6
45	6 50	6 58	7 00	7 01	7 10	7 16	7 21	23	12
54	7 00	7 07	7 12	7 17	7 24	7 31	7 39	21	19
10	7 09	7 17	7 23	7 30	7 37	7 45	7 55	19	25
10	7 14	7 27	7 34	7 41	7 49	7 59	8 10	17	31
17	7 25	7 36	7 41	7 52	8 01	8 12	8 25	15	6
24	7 31	7 41	7 52	8 2	8 12	8 24	8 38	13	11
34	7 39	7 51	8 03	8 10	8 22	8 35	8 51	11	17
37	7 41	7 57	8 07	8 17	8 30	8 44	9 01	9	23
37	7 48	8 01	8 11	8 21	8 36	8 51	9 09	7	29
39	7 50	8 24	8 14	8 26	8 39	8 55	9 14	5	5
39	7 51	8 05	8 15	8 27	8 40	8 56	9 16	3	11
m.	h m.	h. m.	h. m.	h. m.	h m	h. m.	h m	d.	L.
4	47	54	52	54	56	58	60	d.	L.

South Latitude.

PROPOSITIONS

OF THE

Calendar.

What a Year and Month is; also the Prime, Epact and Dominical Letter.

A Common Year is 365¼ Days: A Leap Year is 366 Days.

A Month is either Solar, Lunar, or Civile.

The Solar Month is the ſpace of time that the Sun is in paſſing a Sign, that is the one twelfth part of the Ecliptick, or 30 degrees, which is about 30 days.

The

The Civile Month is a ſpace of time more or leſs, according to the pleaſure of the Magiſtrate, or the Civil Power, and are in our Calender according to this old Rhime,

Thirty Days hath September,
April, June, *and* November:
All the reſt have thirty one,
Save February *alone,*

Which hath but 28 in Common Years, and 29 in the Leap Year.

The Lunar Month is either Periodical, or Synodical.

The Periodical Month is 27 days, 7 hours, 43 minutes, being the ſpace of time in which the Moon paſſing from one point of the Zodiack through the twelve Signs, returns to the ſame again.

The Synodical Month is about 29 days and a half, the ſpace of time between one Conjunction of the Sun and Moon, and another.

The Prime, or Golden Number

Is a Revolution of 19 of our Civil Years, at the end of which time all the Aſpects of the Sun and Moon fall on the ſame days of the Months they did nineteen years before.

The Epact

Is a number multiplex of 11 days, which the common Solar Year doth exceed the Lunar by, and is never to exceed 30, because the Moon's Age is never above 30.

The Dominical Letter

Is always one of these seven, A, B, C, D, E, F, G; and doth shew Sunday in the Calendar all the year round.

1. *To find the Bissextile or Leap-Year, or what Year after Leap-Year, any Year of the Lord propounded is.*

Divide the Year of the Lord by 4, and if nothing remain, that very Year is Leap-Year; but if any thing remain, that will shew what year after Leap-Year it is, and the Quotient gives the number of Leap-Years that have been since the Birth of *Christ*.

The Year 1685, what year after Leap-Year is it? The Quotient, 421, shews there have been 421 Leap-Years, and that the year 1685 is the first after Leap-Year.

2. *To*

2. *To find the Prime, or Golden Number.*

Add 1 to the Year of the Lord, and divide by 19, the remainder is the number fought, and the Quotient ſheweth how many Revolutions of this number hath paſſed ſince the Birth of Chriſt.

Admit the Prime for the year 1683 were required.

1

19) 1684(88
152

164
152

12

The Prime is 12 : and there will have been 88 Revolutions.

3. *To find the Epact.*

Multiply the Prime by 11, and divide the Product by 30, and the Remainder is the Epact.

Admit

Admit the Epact for the year 1703 be required.

1703
1

19) 1704 (89
152

184
171

Remaind. 13 The Prime.
11

13
13

30) 143 (4

23 The Epact.

4. *To find the Age of the Moon.*

Add to the day of the Month the Epact, and so many days more as are months from *March* to the Month you are in, including both months, and if that sum be under 30, that is the age; but if it exceed 30, take away 30, and the over-plus is the Moon's Age.

This

This is when the Month hath 31 days; but if the Month has but 30 days, you must take away only 29.

The fifth of *December*, 1680 I desire to know the Moon's Age.

1680
1

19) 1681 (88
16

9 The Prime.
11

30) 99 (3

9 Epact.
10 Number of Mon.
5 Days.

24 The Moon's Age.

5. *To find the Time of the Moon's Southing.*

Multiply the Moon's Age by 4, dividing the Product by 5, the Quotient gives the hours, and the Remainder multiplied by 12, the minutes over. But if she be above 15 days old, cast away 15, and take the Remainder to work with.

The

The time of the Moon's Southing is required
October, 17, 1684.

1684
1

19) 1635 (88
16

13 The Prime.
11

13
13

30) 143 (4

23 The Epact.
8 Months.
17 Days.

48
30

18 Overplus.
11

7 Rem.
4

5) 12 (2 h. 24 min.
2
12
24

So that the time of Southing is twenty four minutes after four of the clock.

The reason why you multiply by 4. and divide by 5. is because the Moon culminates by 4 of an hour every night later than the night before.

Note, that between the New and the Full the Moon comes to the South in the Evening, but after the Full, in the Morning.

To find the Time of High-water.

Look the Moon's Age in the first column of this little Table, and the number right against it in the second, being added to the hour of High Water on the Change-day, the sum is the exact time of High-Water at the place and time proposed.

Admit the Time of High-Water at *London-Bridge* be required for *June* 25, 1682, I find by the former direction the Moon's Age for the proposed time to be which looked in this small Table, under it's Title, Moon's Age, right against it in the other column is to which I add 3 hours, because a S. W. Moon, or at three of the clock it's found to be High Water here on the Change, or Full, and the sum is the true time of High Water, *June* 25, 1682, the time proposed.

The

The Tyde Table.

Moon's Age.			Tyde.	
Days.			H.	M.
1	—	16	00	43
2	—	17	01	20
3	—	18	01	52
4	—	19	02	22
5	—	20	02	52
6	—	21	03	26
7	—	22	04	07
8	—	23	04	55
9	—	24	05	50
10	—	25	06	53
11	—	26	07	59
12	—	17	09	04
13	—	28	10	08
14	—	29	11	05
15	—	30	12	00

The Moon being 11 days old, till what of the clock ſhall it flow at *Flaſhing*, where a N. by E. and S. by W. Moon makes a Full Sea on the Change-day?

The 11 days looked in the Table gives 7 h. 59 min. to which 0 h. 45 min. the time attributed to the N. by E. Point being added, the ſum 8 h. 44 min. is the true time of High-Water at *Flaſhing*, always when the Moon is 11 days old.

7. *To find the Dominical, or Sunday-Letter.*

To the year add it's fourth part and 4, dividing the ſum by 7, the remainder of this diviſion taken from 7, and the reſt ſhews the Dominical Letter, that is, if 7 remain *G* is the Letter: if 1, *A*: 2, *B*: 3, *C*, &c.

In the Leap-Year there are two Letters uſed: the one found by this Rule ſerves from S. *Matthias* to the laſt of *December*: but the Letter preceding is uſed from the firſt of *Jan.* to S. *Matthias* day.

Admit

Admit the Dominical Letter be required for the year 1680.

4) 1680
420
4 7

7) 2104
300 4
1

The remaining 4 after the division by 7, being taken from 7, leaves 3, which gives C for the Sunday Letter, but considering it's Leap-Year, this will serve but from St. *Matthias* day: and from *Jan.* 1, till S. *Matthias*, D must be the Letter.

Note that the Epact changeth always the first of *March*, but the Dominical Letter and Prime the first of *Jan.*

2. *To find on what day of the week the first of* March *in any year proposed shall fall.*

To the year add it's fourth part and 2, dividing the sum by 7, the remainder of the division gives the number of the day of the week: as if 1 remains, it's Sunday: if 2, Monday, &c.

EXAMPLE.

If I would know what day of the Week the first of *March* shall be this year 1680.

4) 1680
420
2

7) 2102
300

Rem. Which 2 gives Monday.

A Table

A Table of the Movable Feasts

Yc.	Shro. Su.	East. Su.	Asce day.	Whit Su.
81	*Febr.* 13	*Apri.* 3	*May* 12	*May* 22
82	*Febr.* 26	*Apri.* 16	*May* 25	*June* 4
83	*Febr.* 18	*Apr.* 8	*May* 17	*May* 27
84	*Febr.* 10	*Mar.* 30	*May* 8	*May* 18
85	*Mar.* 1	*Apri.* 19	*May.* 28	*June* 7
86	*Febr.* 14	*Apri.* 4	*May* 13	*May* 23
87	*Febr.* 6	*Mar.* 27	*May* 5	*May* 15
88	*Febr.* 25	*Apri.* 15	*May* 24	*June* 3
89	*Febr.* 10	*Mar.* 31	*May* 9	*May* 19
90	*Mar.* 2	*Apri.* 20	*May* 29	*June* 8
91	*Febr.* 23	*Apr.* 12	*May* 21	*May* 31
92	*Febr.* 7	*Mar.* 27	*May* 5	*May* 15
93	*Febr.* 26	*Apri.* 16	*May* 25	*June* 4
94	*Febr.* 18	*Apri* 8	*May* 17	*May* 27
95	*Febr.* 3	*Mar.* 24	*May* 2	*May* 12

till the Year 1710.

Ye.	Shro. Sn.	Eas. Sun.	Ascen. day.	Whit-Sn.
96	Febr. 23	April. 12	May 21	May 31
97	Febr. 14	April. 04	May 13	May 23
98	Mar. 6	April. 2	June 2	June 12
99	Febr. 19	April. 9	May 18	May 28
700	Febr. 11	Mar. 31	May 9	May 19
1	Mar. 2	April. 20	May 29	June 8
2	Febr. 15	April. 5	May 14	May 24
3	Febr. 7	Mar. 28	May 6	May 16
4	Febr. 27	April. 16	May 25	June 4
5	Febr. 18	April. 8	May 17	May 27
6	Febr. 3	Mar. 24	May 2	May 12
7	Febr. 23	April. 13	May 22	June 1
8	Febr. 15	April. 4	May 13	May 23
9	Mar. 6	April. 2	June 2	June 12
10	Febr. 19	April. 9	May 18	May 28

Remarkable Days.

Valentine,	February 14.
S. George,	April 23.

Fix'd Feasts.

Circumcision, or New-years day.	*Jan.* 1
Epiphany, or Twelfth-day.	*Jan.* 6
Conversion of S. *Paul.*	*Jan.* 25
Martyrdom of King *Charles* I.	*Jan.* 30
Purification of the Virgin *Mary*, or *Candlemas-day.*	*Febr.* 2
S. *Matthias.*	*Febr.* 24
Lady-day.	*March* 25
S. *Mark* Evang.	*April* 25
S. *Philip* and *Jacob*, or *May day.*	*May* 1
Birth and Return of King *Charles* II.	*May* 29
S. *Barnabas* Apostle.	*June* 11
Midsummer, or S. *John Baptist.*	*June* 24
S. *Peter* Apostle.	*June* 29.
S. *James* Apostle.	*July* 25
S. *Bartholomew* Apostle.	*August* 24

S. *Matthew* Apoſtle.	*September* 21
Michaelmas, or S. *Michael* the Archangel.	*September* 29
S. *Luke* Evang.	*October* 18
S. *Simon* and *Jude*.	*October* 28
All Saints.	*November* 1
Powder-Treaſon	*Nov.* 5
S. *Andrew* Apoſtle.	*Novem.* 30
S. *Thomas* Apoſtle.	*December* 21
Chriſtmas-Day.	*Decem.* 25
S. *Stephen*, Proto-Martyr.	*Dec.* 26
S. *John* Evangeliſt.	*Decem.* 27
Innocents.	*Dec.* 28

Note that S. *Matthias*-day is on *February* 25, in the Leap-Years.

To find the Moon's Diſtance from the Sun.

MUltiply her age by 4, dividing the product by 10, and the Quotient will be the ſigns that the Moon is diſtant from the Sun: then the remainder multiplied by 3 will give the degrees of that ſign.

EXAMPLE.

Let her distance from the Sun be required.
August 25, 1684.

1

19) 1695 (88
152

165
152

13 The Prime.
11

13
13

30) 143 (4

21 The Epact.
6 Months.
25 Days.

54 The Sum.
30 Subtr.

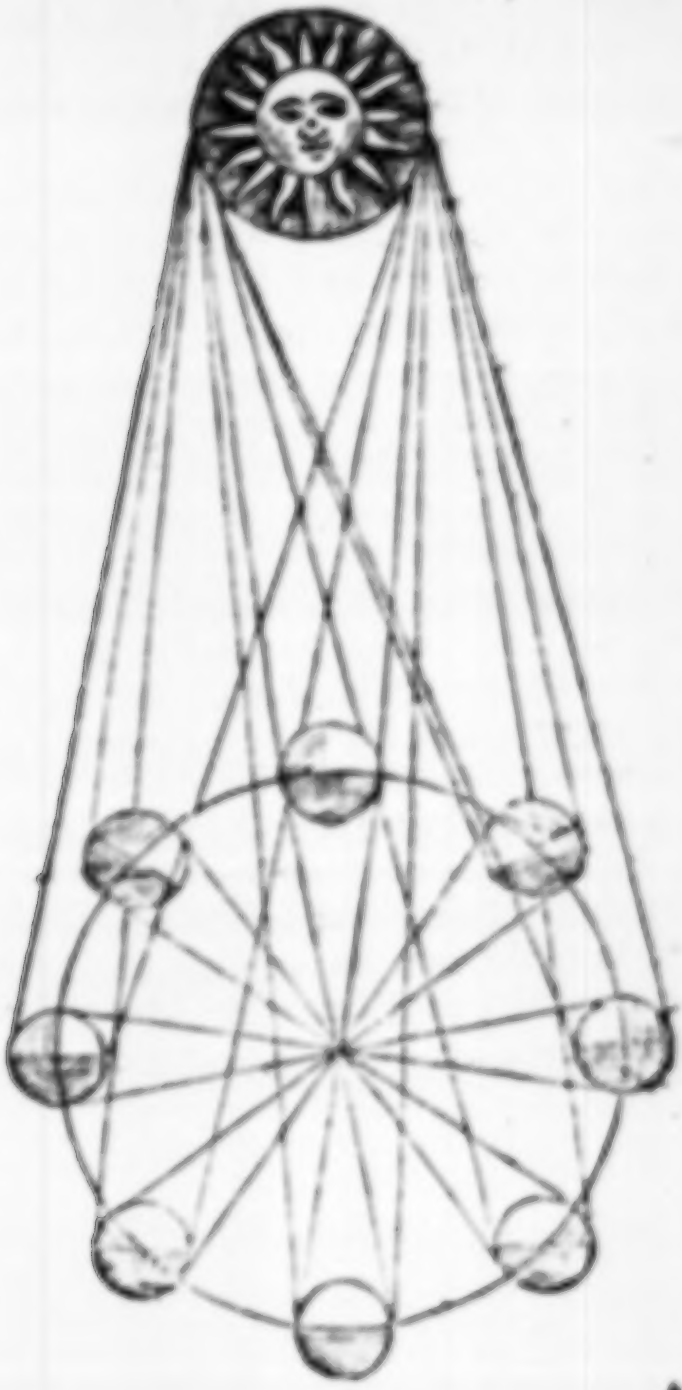
24 The Moon's Age.
4

10) 96 That is 9 h. 18 min. the Moon's distance from the Sun.

According

According to this distance is the variation of her Phases: for she being a round opaq; globous body, and having always that Hemisphere of her that beholdeth the Sun inlightned, she must of necessity, as she moves round the earth, changing her situation both in respect of the Sun and us, have a different appearance by turning more or less of the illuminated Hemisphere towards us.

Her Phases are wont to be counted four, according to her fourfold Aspect, the Conjunction being esteemed none, seeing her inlightened half is then wholly turned from us.



Aboue

About the third day after the Conjunction, she emerges in the Evening out of the Sun's Rays, and turns a small part of her illuminated side towards us, beginning to appear sharply horned, her horns looking backward, and tending towards the East: for note, that while she increaseth in light, she followeth the Sun, and shineth after Sun-set, her inlightened part looking into the West; but decreasing she goeth before the Sun, and shineth before his Rising, her illuminated part looking into the East. And when she comes to make about a Sextile Aspect with the Sun, that is, about two signs from the Sun, is her first face, called Horned. She makes her second Phase about the seventh or eighth day of her age, being then about 90 degrees, or at a square to the Sun, appearing half inlightened, or bisected. Afterward coming to her Trine with the Sun, she appears Gibbous, turn'd or swelled; which is her third Phase. Her fourth is, when in Opposition to the Sun, she appears wholly illuminated, and is called her Full. She makes the like Phases in her decrease, but in a retrograde order.

An

An Universal Almanack.

Mar. Nov.	Aug	May. Jan.	Oct.	April July.	Sept. Dec.	June. Febr.
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

On the same day of the Week the first of *March* falls on, will the first of *February* and *November* fall; and the several days of the several Months as in that.

The Use of this Almanack.

1. *Any Day of the week in any Month or Year being given to know what Day of the Month it is.*

As admit I would know what day of the Month

Month the first Thursday in *April*, 1680, should be.

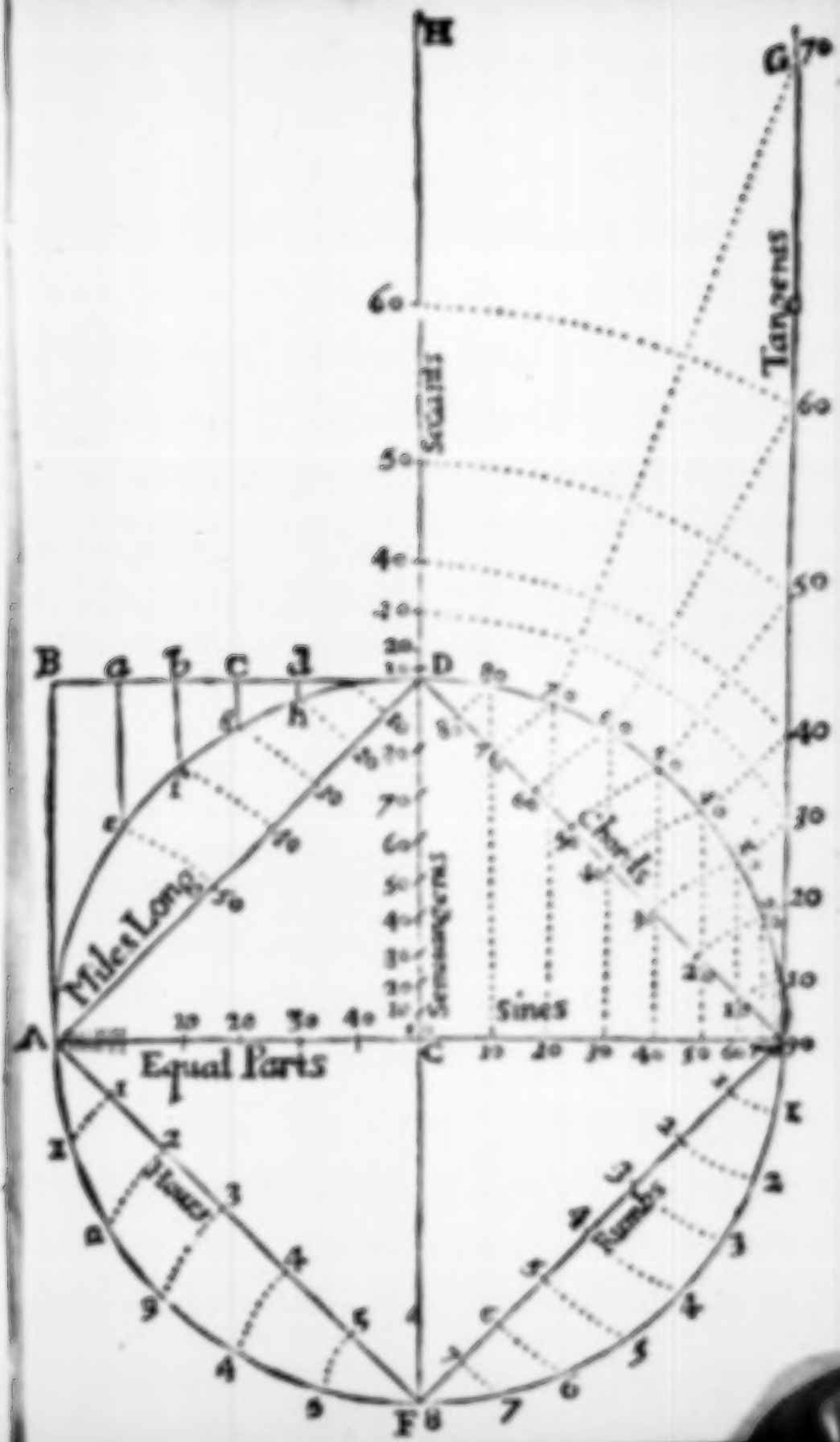
By the last Proposition I find the first of *March* to be Monday. Now looking in the Almanack (at the head thereof) for the Month *April*, under it I find these numbers, 5, 12, 19, 26, which denote the fifth, twelfth, nineteenth and twenty sixth days of *April*, to be Mondays, the same with the first of *March*; then the fifth day being Monday, Thursdays must be the first and eighth of *April*.

2. *Let it be required to find what day of the week the twenty fifth of* July *will be in the Year*, 1680.

The first of *March* will be Monday, therefore the fifth, twelfth, nineteenth and twenty sixth days of *July* will be Mondays: then the twenty sixth being Monday, the twenty fifth must be Sunday.

To

Betwixt this Page, *folio* 70, and *folio* 71, place the Cut belonging to Secants and Tangents, &c.


H
G
Tangents
Secants
Miles Long
Equal Parts
Sines
Chords
Semitangents
Semisecants
Leagues
Rumbs
A
B
C
D
E
F

To make the Lines of Chords, Natural Sines, Tangents, Secants, Semitangents, Rumbs, Hours and Minutes Longitude.

1 DEscribe a Circle, as *A D E F*, and quarter it with the two Diameters, *A E*, *D F* at right Angles one to the other.

2. Divide the Arch *D E* into nine equal parts, and setting one foot of the Compasses in *E*, transfer the divisions of the Arch, marked 10, 20, *&c.* to the strait Line *E D*, so is *E D* a Line of Chords for every ten degrees; the single degree may be divided by guess.

3. Through the divisions 10, 20, *&c.* draw Parallels to *C, D*, which will divide *C E* into a Line of Sines.

4. On *E* raise *E G* perpendicular to *C E*, and laying a Rular over *C*, and the Points 10, 20, 30, *&c.* draw the Lines 10, 10, 20, 20, *&c.* so is *E G* a Line of whole Tangents.

5. Setting one foot on *C*, extend the other to the several grad. of the Tangent-Line *E G*, and describe the Arches 10, 10; 20, 20, *&c.* which makes the Line *C, D, H*, a Line of Secants.

6. Laying a Rular over *A*, and the gr. 10, 20, 30. *&c.* of the Arch *E D*, mark the Line *C D*, which becomes a Line of Semitangents.

CHAP.

CHAP. I.

NAVIGATION

Teacheth and demonſtrateth how a ſufficient Ship may be conducted the ſhorteſt way, and in the ſhorteſt time between any places aſſigned in Paſſages Navigable.

The Diviſion of Navigation according to the Voyage.

IF the places aſſigned be at no great diſtance, but ſo that a Ship may ſail in ſight of Land, or within Soundings between them, then it is called a *Coaſting*.

Coaſting.

For the performance of which there are uſed only the Compaſs and Lead, or Sounding Line:

Line: such are the Voyages on the Narrow, or British Seas, between *England*, *Holland* and *France*; also all about the *Baltick* Seas, and indeed those in the *Mediterranean* are little other.

Navigation Proper.

But if the Voyage be to be performed in a vast Ocean, where all that's visible for many days, nay weeks together is *nil nisi ponius & æther*, then it may be called *Navigation Proper*, and requires not only the Lead-Line, and ordinary Compass, but Azimuth Compass, Charts, Log-board, and half minute Glass, with Instruments for Cœlestial Observation; as the Quadrant and Fore-staff, *&c.* and the Navigator must be able by these to find at any time in what place the Ship is, which is done by comparing it with any known place, that is, how much the same known place is situate from the ship, either towards the North or South, which is called the difference of Latitude, or towards the East or West, which, if in proper degrees, is called the difference of Longitude.

To find which place of the ship, how far she hath sailed, and consequently how far she hath to sail, and which way, or upon what course, *&c.* you have these things given, or at most times to be attained; the Latitude both of

of the place wherein she is, and whence she set sail, as also that of the place she intends for. Secondly her course which is given by the compass: and thirdly, the account of the ships way attained by the Log. How to state and order these things given to produce those required shall in the next Chapter be shewed.

Difinitions.

Latitude is the distance of a Ship or Place from the Equinoctial, either North or South, and is counted on the Meridian.

And note, that if a ship sail towards the Pole, she is said to *Raise the Pole*; but if she sail from the Pole, or towards the Equinoctial, she's said to *Depress the Pole.*

Longitude is the distance of a ship or place, East or West from another counted in proper degrees: but if in Leagues, or Miles, or Degrees of the Meridian, and not in those proper to the Parallel of Latitude, it's commonly called Departure, Separation, Easting, or Westing, &c.

The Course is that point of the Compass, or Coast of the Horizon on which the ship is to be steered from place to place; or rather the Angle between the Rumb Line and the Meridian.

A Rumb is one Point of the Compass, or eleven

eleven degrees and a quarter, *viz.* the one thirty two parts of the Circumference of the Horizon, or Compaſs-Card: which is the Repreſentative of the Horizon.

A Rumb Line is a Line deſcribed by the ſhips motion on the ſurface of the Sea, ſteered by the Compaſs, making equal Angles with every Meridian.

The Rumb is the ſame with the Courſe, *viz.* the Angle between the Rumb Line and Meridian, only the one is a Portugueſe, and the other an Engliſh Word.

The

The Compass Card with its Rumbs or Points.

The Distance of the Rumbs, or Points from the Meridian.

North	South.	D.	M.	South	North.	P.
		2	49			
		5	38			
		8	26			
N by E	S by E	11	15	S by W	N by W	1
		14	4			
		16	53			
		19	41			
NNE	SSE	22	30	SSW	NNW	2
		25	19			
		28	8			
		30	56			
NE by N.	SE by S	33	45	SW by S	NW by N	3
		36	34			
		39	23			
		42	11			
NE	SE	45	0	SW	NW	4
		47	49			
		50	37			
		53	26			
NE by E	SE by E	56	15	SW by W	NW by W	5
		59	04			
		61	52			
		64	41			
ENE	ESE	67	30	WSW	WNW	6
		70	19			
		73	07			
		75	56			
E by N	E by S	78	93	W by S	W by N	7

Navigation or Sailing, in reſpect of the Rumb or Point ſailed on, is aptly divided into Right and Oblique.

Right Sailing.

Right Sailing is, when the Voyage is performed on ſome of the four Cardinal Points, that is, North, South, Eaſt or Weſt.

If a Ship ſail under a Meridian, that is, on the North or South Points, ſh: varieth not the Longitude at all, but only changeth the Latitude, and that juſt ſo much as the number of degrees ſhe has ſailed.

If a ſhip ſail under the Equinoctial upon the very Eaſt or Weſt Points; ſhe altereth not her Latitude at all: but only changeth the Longitude, and that juſt ſo much as the number of degrees ſhe hath run.

If a ſhip ſail directly Eaſt or Weſt under any Parallel, ſhe there alſo altereth not her Latitude, but only the Longitude; yet not according to the number of degrees of a Great Circle ſhe hath ſailed, as under the Equinoctial: but more than ſo many according as the Parallel is remoter from the Equinoctial towards the Pole: for the leſs any Parallel is, the greater is the difference of Longitude in ſailing ſo many degrees of a Great Circle.

Oblique

Oblique Sailing.

Oblique Sailing is when the ſhip runneth upon ſome Rumb between any of the four cardinal Points, making an Oblique Angle with the Meridian: and then ſhe changeth continually both Latitude and Longitude.

The Diviſion of Navigation according to the Chart.

There be three kinds of Oblique Sailing, or rather methods of protracting the way, and pricking down the place of the ſhip.

Plain Sailing.

The firſt is called Plain Sailing, manifeſting all the varieties of the ſhips motion on a Plain, where all the Meridians are made parallel, and the Parallels at right Angles to the Meridians, and the degrees of each Parallel equal to thoſe of the Equ. Which tho notoriouſly falſe in it ſelf, ſuppoſing the Earth and Sea to be a plain flat, and each parallel equal to the Equator, yet by breaking a long Voyage into many ſhort ones, a Voyage may pretty well be performed thereby, near the ſame Meridian.

Mercator's Sailing.

The ſecond is called *Mercator's*, or more truly *Wright's* Sailing, or ſailing by *Wright's* Chart, which demonſtrateth alſo on a Plain the motion of the Ship, upon any courſe aſſigned true in Longitude, Latitude and Diſtance, the Meridians being alſo parallel, and the Parallels of Latitude ſtrait Lines.

Great-Circle-Sailing.

The third is Great-Circle-Sailing, which teacheth how upon, or by a great Circle, paſſing through any two places aſſigned, the ſhip may be conducted by a skillful Seaman: and this is the ſhorteſt way between place and place that may be.

The Operation of all which three kinds ſhall be ſhewed by Delineations, or Geometrically; by Computation, or Arithmetically; and Mechanically or Inſtrumentally. If the uſe of a Line of Chords may be admitted in Geometry.

CHAP II.

Plain Sailing.

FOr Methods ſake make always the fore part of the Book, Slate, or whatever elſe you draw, or work upon, the North part, that neareſt to you the South, then will that part towards the Right Hand be the Eaſt, and that towards the Left Hand the Weſt, and imagine that by the Rumb Line, Meridian, and Parallel of Latitude will always be formed a right angled Triangle, as the Triangle B, A, C, right



angled at A, (for ſo ſhall the right Angle be always marked throughout the work:) The

is that part of the Meridian, or North and South Line contained between A and C the Difference of Latitude, the side B A the Departure, B C the distance sailed, the Angle C the Course, and the Angle B the Compl. thereof. Any two of which with the right Angle being given, the Triangle may be protracted, and the other three parts found, as in the following Examples.

CASE I.

The Course and Distance given to find the Difference of Latitude and Departure.

Admit a ship from the Latitude fifty degrees, ten minutes North, sail S. S. W. 48·5 miles, and you require the Latitude she's in, and her departure from the Meridian.

Geometry.

First draw the North and South Line A C



and taking with the Compaſſes ſixty degree from the Line of Chords, ſet (becauſe ſh ſails Southward) one foot in ſome point to wards the North on the ſaid Line A C, as a C, and deſcribe the Arch D E, and lay them on the Courſe two points, or twenty two de grees, thirty minutes from E to D, and draw C B. Secondly, taking the given diſtanc 48·5 from the Line of equal parts, lay it o the Rumb Line C B, from C to B. Laſtly from B let fall the perpendicular B A, whic includes the Triangle B A C, whoſe requir parts B A and A C being taken one after th

oth

ther between the Compasses may be measured by applying to the Scale.

Arithmetick.

Say as the Radius	10	
Is to the distance run B C 48·5 miles——	1,685742	
So is the Sine of the Course 22 deg. 30 m.	9,582870	
	11,268582	

To the departure 18·56
Which in this Example is Westing.

Then again,

As the Radius——————	10	
Is to the distance B C, 48·5	1,685742	
So is the Cosine of the Course 67 deg. 30 min.	9,965615	
	11,651357	

To the difference of Latitude C A. 44·8.
Which because she sailed towards the Equator, you must substract from the Latitude she set from, viz. 50 degrees, 10 minutes, and the Remainder 49 deg. 25 minutes is the Latitude she's arrived in. If C A had been more than 60, you must have divided by 60.

By this Canon was the Table, beginning page made; and by that Table may this

Proposition be readily worked, for by looking the Course on the head, and the distance down the Left Hand Column in the common Angle is the difference of Latitude and Departure under their respective Titles. If the Course be above four Points, look it at the bottom, and if the distance be too big to be found in the Table at once, take it at several times.

Instrument by Gunter's Scale.

Set one foot of the Compasses in the Radius, or Sine of 90 degrees, and extend the other to two points on the Sine Point Line, or on 22 deg. 30 min. of the Sines: Then keeping that extent, set one foot in 48·5 of the Line of Numbers, and turning the other backwards, viz. that way you did turn it from the first term the Radius, to the third two Points, and the other foot will fall on 18·6 the departure as before. Again set one foot in the Radius, and extend the other to six points (which is the Compl. of two Points, the Course.) then keeping that extent, set one foot in 48·5 of the Line of Numbers, and turning the other foot back it will fall on 44·8, the difference of Lat. as above.

Which difference of Latitude and Departure being found by the estimate distance from the Log, which by many accidents

accidents is viciated, as by the Wind and Seas when high, throwing it after the Ship, or Currents, *&c.* is naught, and not to be relyed on, but as soon as the Sun or Stars appear, the Latitude ought to be observed by the Rules following towards the end of this Treatise, which if found differing from what it was made by the former way, called Dead Reckoning, you must take the difference of this last observed Latitude, and the Latitude you departed from; and with this true difference of Latitude, and the Course by the following Proposition find the Departure and Distance.

CASE II.

The Course and Difference of Latitude being given to find the Departure and Distance.

Admit a ship sail from Latitude 48 degrees, 30 minutes North, S. S E. a quarter Easterly, till she be in Latitude 47 deg. 21 min. and the Departure and Distance sailed be required.

Geometry.

First, draw the North and South Line C A, and substracting the Latitudes one from the other, take 69 miles, their difference, and set from C to A, making the point C towards the

Lat. 48 deg. 30 min.



Lat. 47 deg. 21 m.

Upper, or North End of the Line, and on A, raise the Perpendicular B A.

Lastly, taking the Radius, and setting one foot in C, with the other describe the Arch D E, and lay thereon two Points and a quarter, or twenty five degrees, nineteen minutes from E to D, and draw C D, which completes the

Triangle

Triangle B A C, whose required parts may be measured by the Scale.

Arithmetick.

Say, as the Cosine of the Course five Points, three quarters,	9,956148
Is to the difference of Lat. 69 miles.	1,838849
So is the Radius	10,000000
	11,838849
To the distance sailed C B 76·2.	1,882701
Then, as the Radius	10,000000
Is to the distance sail'd C B 75·3	1,882701
So is the Sine of the Course. two Points and a quarter of the Angle C	9,631059
To the Departure A B 32·6 miles.	11,513750

By this Canon was the second Traverse Table calculated; and by that Table may this Proposition be answered by inspection: for by looking the Course on the Head, and the difference

ference of Latitude down the left Column in the common Angle you have the Departure.

Instrument.

Set one Foot of the Compasses on the S. E. Line, in five Points and three quarters, the compl. of the Course; and extend the other to the Radius; then keeping the Compasses at the same extent, set one foot in 69, the difference of Latitude on the Line of Numbers, and turn the other forward, and it will fall on 76·3 the Distance run.

Then set one foot in the Radius, and extend the other to two Points and a quarter; then keeping the Compasses at the extent, set one foot in the distance sailed, and turn the other back (because it was turned back before from the Radius to two Points and a quarter, and it will fall on 32·6 the Departure.

If having no cause to suspect the distance for the former, or any other reasons, and are assured in your self of having made a good estimate thereof: but mistrust the care or skill of the Helmsman, that he has let her yaw and fall off, or that you have neglected the Variation, then with the true difference of Latitude, and the distance by the following Proposition, find the Course and Departure.

CASE

CASE III.

The Difference of Latitude and Distance sailed given, to find the Course and Departure.

Admit a ship sail from Latitude forty two degrees, fifteen minutes North, on some point between the North and West eighty eight miles, and then finds her self in Latitude, forty three degrees, thirty minutes: what is her Course and Departure?



Geometry.

Having drawn the Meridian Line AC prick the difference of Latitude seventy five miles from C to A; and on the Point A raise the Perpendicular B A; then take the distance eighty eight miles, and setting one foot in C, with the other cross B A, as it will somewhere as in B, and draw B C, now the Line B A measured on the equal parts is the Departure. Also upon C as a Center, with sixty degrees of the Chords, describe the Arch D E, which measured on the Chords or Rumbs shews the Course two points and three quarters from the North Westward, *viz.* N. N. W. two parts of four Westerly.

Note, that where ever a side is to be measured, or laid down as the Distance, Departure, or Difference of Latitude, you must always use the equal parts; but when an Angle the Chords.

Arithmetick.

As the Distance run, C B 88-1:944483

Is to the Radius ——— 10 ———
So is the Difference of Latitude C A 75 ——— 1,875061 ———
11,875061

To

To the Cosine of the Course, Angle B 58 degrees, 27 m. } 9,930578
Whose Compl. C 31 deg. 33 min. is two Points and three quarters from the Meridian, *viz.* N. N. W. three parts of four Westerly.
Then as the Radius —— 10 ——

Is to the Distance run C B 88 miles. } 1,944483
So is the Sine of the Course's Angle C, 31 deg. 33 min. } 9,718703

To the Departure from the Meridian A B 46 m. West. } 11,663186

By the Gunter.

Set one foot in 88 of the Line of Numbers, and extend the other to 75; then set one foot in the R. or Sine of ninety degrees, and turn the other backward, and it will fall in the Sine of 58 degrees, 27 min. the Compl. of the Course.

Again set one foot in the Radius, and extend the other to the Sine of 31 deg. 33 min. then set one foot in 88 min. and turn the other backward, and it will fall on 46 min. the Separation from the Meridian.

CASE

CASE IV.

The Diſtance run, and Departure from the Meridian given, to find the Courſe and Difference of Latitude.

A ſhip being in the Latitude 50 deg. 00 m. North, ſails North Weſtwards, till her diſtance run be 74·6 miles, and the Departure be 40·5, from which is demanded the Courſe and Difference of Latitude, and conſequently the Latitude the ſhip is in.



Geometry.

Having drawn the Meridian A C on the Point A, taken ſomewhere towards the upper or North end of the Line (becauſe the ſhip ſails Northward) raiſe the Perpendicular B A, laying thereon 40·5 miles, the Departure from A to B; then take the diſtance 74·6 miles, and ſetting one foot in B, with the other croſs the Meridian A C in C, and draw B C.

Arithmetick.

As the Diſtance run B C 74·6 ——— } 1,872739

Is to the Rad. ——— 10 ———

So is the Departure B A 40·5 -- 1,607455

To the Sine of the Courſe 11,607455

9,734716

Angle C, 32 degrees, 51 minutes, which is three Points from the Meridian, *viz.* North Weſt by North nearly.

Then as the Rad. ——— 10 ———

Is to the diſtance B C 74·6 ---- 1,872739

So is the Coſine of the Courſe, 2. 57 deg. 7 min. } 9,924164

11,796903

To the difference of Latitude A C 62·6 miles, which

which turned into Degrees, is one degree, three minutes, and is to be added to 50 degr. 00 minutes, the Latitude she departed from, because she raises the Pole: so is the sum 51 deg. 3 min. the Latitude the ship is in.

By the Gunter.

Set one foot of the Compasses in 74·5 miles, and extend the other to 40·5; then keeping the same extent, set one foot in the Sine of 90 degrees, and turn the other backward, and it will fall on the Sine of 32 degr. 53 min. the Course.

Again set one foot in the Sine of 90 degrees, and extend the other to the Sine of 57 degrees, 7 minutes, the compl. of the Course, then retaining the same extent, set one foot in 74·6 of the Line of Numbers, and turn the other backward, and it will fall on 62·6 the Departure.

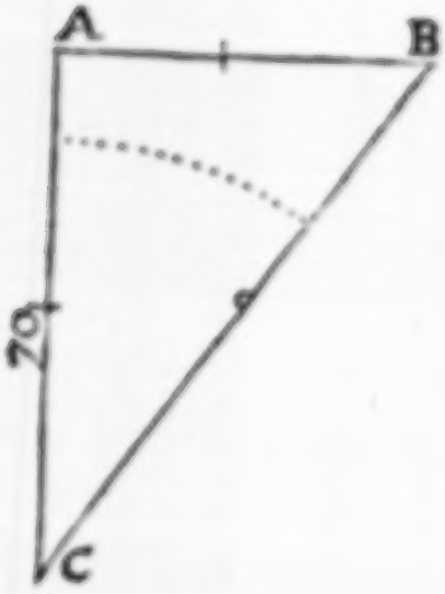
CASE V.

The Alteration of Latitude and Departure from the Meridian given, to find the Course and Distance ran.

A ship from the Latitude 50 deg. 00 min. North, sails North-Eastward till she has altered her Latitude 1 deg. 10 min. or 70 miles, and

is

is departed from the Meridian 51 miles; what is her Course and Distance?



Geometry.

Having drawn A C, and laid thereon the 70 minutes from C to A, and on A raised the Perpendicular A B, lay 70 m. from A to B, and draw B C.

Arithmetick.

Arithmetick.

As the difference of Latitude A C 70 miles. } 1,845098
Is to the Rad. 10
So is the Departure A E 51 1,707570

11,707570

To the Tangent of the Course, Angle C, 43 d. 14 m. } 9,862472
Which is three Points and three quarters, or North-East by North, three parts of four Northerly, nearly.
Then as the Sine of the Course, Angle C, 43 degrees, 14 min. } 9,835672

Is to the Departure, A E 51 1,707170
So is the Radius 10,000000

To the distance E C 74.4 miles. } 11,707570 / 1,871898

By the Gunter.

Set one foot of the Compasses in 70 m. and extend the other to 51 of the Line of Numbers; then keeping the same extent, set one foot in the Tangent of 45 degrees, turning the other backward, and it will fall on the Tangent 43 degrees, 14 min. the Course.

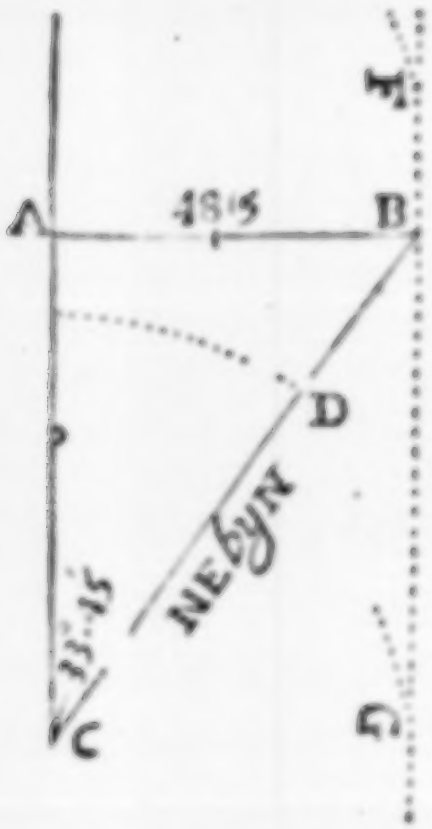
Again

Again ſet one foot in the Sine of 43 degr. 14 min. and extend the other to the Sine of 90 degrees, then keeping the ſame extent, ſet one foot in 61 of the Line of Numbers, turning the other forward, and it will fall on 74 4 the diſtance.

CASE VI.

The Courſe and Departure given, to find the Diſtance and Difference of Latitude.

A ſhip from Latitude 43 degrees, 30 min. North, ſails North Eaſt by North, till her departure from the Meridian be 48·5 Leagues; what is the Diſtance ſailed, and Difference of Latitude?



Geometry.

Having drawn the Meridian A C, and on the Point C taken somewhere towards the lower or South End, as a Center with the Chord of 60 degrees, described the Arch D E, and laid thereon three Points from E to D, and thereby drawn the Rumb Line C B, at the extent 48·5, taken from the Scale of equal parts, draw a Parallel to A C, as F G cutting the

the Rumb Line in B, from which Point B let fall a Perpendicular to A C as B A.

Arithmetick.

As the Sine of the Course 33 deg. 45 min. Angle C } 9,744732

Is to the Departure, A B 48·5 — 1,685742
So is the Radius — 10
To the Distance C B 87·3 Leagues. } 11,685742 / 1,941010
Then, as the Radius — 10

Is to the distance run C B 87·3 — 1,941010
So is the Cosine of the Course, or 1. 56 deg. 15 min. } 9,919846
11,860856

To the difference of Latitude A C 72·6 Leagues. } 1,860856

By the Gunter.

Set one Foot of the Compasses in the Sine of 3 Points, and extend the other to the Radius, or Sine of 8 Points; then keeping that extent, set one foot in 48·5 of the Line of Numbers, and turn the other forward, and it will fall on 87·3 the Distance sailed.

Again, set one foot in 1.8 points, and extend the other to 1. 5 points; then set one foot

foot in 87·3 Leagues, and turn the other backward, and it will fall on 72·6 Leagues, the Difference of Latitude, which is 217·8 miles, or minutes, which divided by 60, makes 3 degrees, 37 minutes, which, because she raises the Pole, I add to 48 deg. 30 min. the Latitude she departed from, and the sum 52 deg. 7 min. is the Latitude she's arrived in.

Thus having laid down the six Cases of sailing, I shall annex a Series of Blank Examples to the former Cases, wherein the Phrase is somewhat altered.

1. If I sail Leagues
how many degrees shall I have raised the Pole?

2. If I sail till I raise the Pole,
or alter my Lat. deg. min. I demand how many miles I have sailed?

3. A ship from the Lat. N,
sails till she be in the Lat.
I demand the distance sailed, and the Departure from the Meridian?

4. Sailing Miles between the North and West, till I raise the Pole, or alter my Latitude deg. min. on what Course have I sailed, and how far am I departed from the first Meridian?

5. If

5. If in ſailing miles, I be miles Weſt from the Meridian of the place I departed from, on what point have I ſailed, and how much have I raiſed or depreſſed the Pole?

6. If I ſail till I be miles from the Meridian of the Place of my Departure: how many miles ſhall I have ſailed, and how much ſhall I have depreſſed the Pole, or altered my Latitude?

CHAP. III.

A Traverſe

IS the Variation, or Alteration of the Ships motion upon the ſhifting of Winds, &c.

Sailing in reſpect of Wind.

Sailing in reſpect of the Wind, is either before a Wind, by a Wind, or Larging.

If

If a ſhip ſail by, or againſt a Wind, there ought to be an allowance for her Lee-way, and that more or leſs, according to the Growth and Surge of the Sea, and Mould of the Ship, and Sail ſhe bears, *&c.*

EXAMPLE L.

A ſhip from Latitude 43 deg. 00 min. N. ſails S. E. by S. 23 miles, and then ſails S. W. by W. 31 miles, and afterwards W. N. W. 40 miles: and laſtly, N. 28 miles: what is the Courſe and Diſtance ſailed from the firſt place of Departure; and the Latitude ſhe is now in?



Geometry.

Take any convenient Point on your Slate, or Paper, for the Ships place at first, as A, and from thence having drawn the Meridian A b, with 60 degrees of the Chords, describe the Arch b c, and lay thereon three Points from b to c, then draw A c, and lay thereon twenty

three miles from A to d; so have you protracted the first Course and Distance.

Secondly, through the Point d, draw the Meridian d e parallel to A b, and with sixty degrees of Chords, setting one foot of the Compasses in d, as a Center describe the Arch e f, laying thereon five Points from e to f, and draw a f, then prick 31 miles from d to g, on the Line d f, so have you laid down the second Course and Distance.

Thirdly, from the Point g draw g h parallel to A b, and with 60 degrees of the Chords describe the Arch h i, laying thereon 6 points from h to i, and draw g i, then prick 40 miles from g to k.

Fourthly, from k draw the Meridian k l parallel to A b, and because she sails now under the very Meridian it self, lay 28 miles, the distance on this Rumb from k to l, which point l is the ships place at the end of this Traverse, then draw l A, and that measured on the line of equal parts, or miles, gives 90·4 miles, the direct distance from the place of Departure, and the Angle A l k being measured on the Chords, gives 82 deg. or 7 Points and a quarter from the Meridian; so that if she had sailed on a straight Line, and single Course from the first Point A to l, that Course had been West by North, and a quarter Westerly, and the distance 90·4 m. and if she were to sail back again from l to A, she must stand East

by South, and a quarter Easterly till she has run 50·4 m.

Arithmetick.

As the Radius ——— 10 ———	
Is to the distance on the first Course 23 m. ———	1,361726
So is the Sine Compl. of 1st. Course, 1. 56 d. 15 m.	9,919846
To the difference of Lat. in the first Course, 191 m	11,281572
Then, as the Radius ——— 10 ———	
Is to the distance A I 23 m. run on the first Course	1,361726
So is the Sine of 3 points, or 33 deg. 45 min. Angle d A B the first Course ———	9,744739
To the Departure in the first Course 12·8 ———	11,106465

Thus proceeding with the several Courses and Distances given, find the Departures and Differences of Latitude to them all.

If the Course be between the North and East, then the Difference of Latitude is called Northing; and the Departure, Easting; if the Course be in the North-West Quarter, then

the difference of Latitude is called Northing and Departure Westing.

If the Course be between the South and East, the Difference of Latitude is called Southing and the Departure Easting, &c.

Now place all the said Differences of Latitude and Departures in a Table; the Northings under Northing: Southings under Southing; the Eastings in the East Column; and the Westings in the West Column, as beneath. Then add up all the Northings, as likewise the Southings; and so the Eastings, as also the Westings. Lastly, substract the sum of the Northings from that of the Southings, if the Southings make most, or the sum of the Southings from the Northings, that you may have their difference, which is the difference of Latitude, also take the difference of the Totals, of Easting and Westing for the Departure: by which difference of Latitude and Departure, according to the fifth Case find the direct Course and Distance.

	d.	m.
Latitud. Depart.	43	00
Diff. Lat.	0	7
Lat. she's in.	43	7

Course.	Mi.	N.	Sou.	East	We.	
S.E. by S.	23		19·1	12·8		
S. W. by W.	31		17·2		25·8	
W. N. W.	40	15·3			36·9	
Nath.	28	28				
Sum		43·3	36·3		62·7	
Take		36·3		12·8	12·8	
Rest		7			49·9	D.W.

As the Diff. Lat. 7 m. —— 0,845098

Is to the Radius —— 10
So is the Dep. 49·9 m. —— 1,698106

11,698106

To the Tang. of the Courſe 82 degr. 1 min. } 10,853008
And as the Sine of the Courſe 82 deg. 1 min. —— } 9,995770

Is to the Departure 49·9 1,698106
So is the Radius —— 10

11,698100

To the Diſt. 50·4 m. —— 1,702336

By the Gunter.

Set one foot in 8 Points, and extend the other to three Points; then with the ſame extent ſet one foot in 23 m. and turn the other backwards, and it will fall in 12·8 the Eaſting in the firſt Courſe.

Set one foot in 8 points, and extend the other to 5 points; then ſet one foot in 23 m. and turn the other backward, and it will fall in 19·1 the Southing in the firſt Courſe.

Secondly,

Secondly, set one foot in 8 points, and extend the other to 5 points; then keeping the same extent set one foot in 21 m. turning the other backward, and it will fall in 25·8 the Westing in the second Course.

Set one foot in 8 points, and extend the other to three points; then keeping the same extent, set one foot in 21 m. turning the other backward, and it will fall in 17·2 the Southing in the second Course.

Thirdly, set one foot in 8 points, and extend the other to six points; then retaining the same extent, set one foot in 40 m. turning the other backward, and it will fall on 36·9 the Westing in the third Course.

Set one foot in 8 points, and extending the other to two points; then set one foot in 40 m. turning the other backward, and it will fall on 15·3 the Northing in the third Course, which Northings, Southings, Eastings &c. being collected as before, and the sums substracted, the Difference of Latitude will be 7 m. North, and the Departure 49·9 West.

Then set one foot in 49·9, and extend the other to 7 m. afterwards remove one foot to 8·45 deg. turning the other backwards, and it will fall on 82 deg. which is the Course from the North Westward. Again, set one foot in the Sine of 82 deg. and extend the other to the Sine 90 deg. then keeping the Compasses

at the same extent, set one foot in 49·9, turning the other forward, and it will fall on 50·4 m. the direct distance from the first place of Departure.

EXAMPLE II.

A Ship being bound to the Eastward, and finding the Wind variable, a small Gale, smooth Water plies upon these several Courses with the distances on each Course as followeth:

The Larboard Tack on Board, Wind from S. S. W. to S. and so to S. S. E. and E.

	Miles.
S. E. by E. half Easterly	5
E. S. E.	4
E. by S.	7
E. half Northerly	3

The Starboard Tack on Board, Wind S. E. E. S. E. E. &c.

S. S. W.	5
S. by W.	6
South	4
S. S. E.	7
S. E. by S.	3

I require the direct Course and Distance from the first place of Departure.

This

This Example I ſhall work only by the Traſe Table, *page* to ſhew the uſe thereof.

Courſe.	P.	D.	N.	Sou.	Eaſt	W.
E. by E. $\frac{1}{2}$ E.	$5\frac{1}{2}$	5		2·4	4·4	
E. S. E.	6	4		1·5	3·7	
E. by S.	7	7		1·4	6·9	
E. $\frac{1}{2}$ N.	$7\frac{1}{2}$	3	0·3		3·0	
S. S. W.	2	5		4·6		1·9
S. by W.	1	6		5·9		1·2
South	0	4		4·0		
S. S. E.	2	7		6·5	2·7	
E. by S.	3	3		2·5	1·7	
Sou.				28·8	22·4	3·0
			0·3	0·2	3·1	
				28·5	19·3	

Having drawn several Columns, and therein set down the several Courses and Distances, as in the Specimen, turn to the Traverse Table, page looking the Course on the Head of the Table, if under 4 points; but at the bottom, if above 4 points, and look the Distance in the Left Hand Column, and in the square of meeting will be the Difference of Latitude and Departure under the respective Titles. Thus, above 5 points and a half, and right against 5 m. I find over the Title Diff. Lat. and m. the Diff. of Lat. and over Dep. 4·4 m. the Dep. in the first Course, which being placed in their proper Columns, according as they are Northing, or Southing, &c. proceed in like manner with all the other Courses and Distances, entring the corresponding Differences of Latitude and Departure in their Columns; then add up the Columns of Difference of Latitude and Departure, substracting the less Difference of Latitude from the greater; and the lesser Departure from the greater, and the Remainders are the whole Difference of Lat. and Departure she hath made from the place of her Departure; so in this Example she is 2[illegible] miles to the South of the place of Departure, and 19 3 miles E. which by Case 5, I find her Course South East by South two degrees Southerly, and distance 34·5 m.

EXAMPLE

EXAMPLE III

Anno 1679, from the ninth to the tenth of *April*, Courſes and Diſtances ſailed by the Log, were a Wind from the South South East variable to the South East by South, an indifferent Gale, and the Variation of the Compaſs, by obſervation 5 degrees East, the true Courſe and direct Diſtance is required.

	m.
E.	32
E. N. E.	22
N. E. by E.	4
S. W. by S.	20
S. S. W.	5
	83

The Courſe being computed by the former method is East 14 deg. South and the Diſtance 44 miles; but by reaſon of the Variation the true Courſe is East 19 deg. South, and diſtance 44 miles, from which I make my Difference of Latitude 14 m. But by my obſerved Latitude 29 deg. 21 m. S. I find I am 4 m. more North than that Account, which ſeeing I have no cauſe to ſuſpect my Courſe, and have been careful in trying, and find no Current, I can attribute to nothing but her Lee-way, which I have

have not accounted for, taking it to be little in smooth Water: therefore by the true Difference of Latitude 10 m. and the Distance 43 m. I compute my Course according to Case 1, and find it E. 13 deg. S. which will again give my Departure 43 m. and Diff. 10 m. according to observation. But if having been well experienced in the qualities of my ship, and certain what allowance to have made for Lee-way, yet had not observed the Variation, I should have argued another way, and attributed the error to Variation, especially if I had made any Tryal for a Current.

To be able to give a good account of the ships place is no light easie thing, but requires besides an experienced Judgment in estimating the ships way, and frequent observation of the Latitude, a perfect understanding the qualifications of the ship, a true and constant observation of the Variation, and no long omission of the tryal for the discovery of Currents: if there be an omission of the observation of any one of these, it may nevertheless be found by the other: but if two or more be omitted, it will be doubtful to which of them to attribute the error, and consequently, hardly any true correction to be made. Yet note this, that if you have omitted every thing but the Course and Distance, as most commonly it happens, then if the Course be less than four points from the Meridian, take the Course to be true, and

with that, and the true difference of Latitude find the Departure: but if the Courſe be above 4 Points from the Meridian, take your diſtance and true difference of Latitude, produced by obſervation, and by them find the Departure; or ſometimes you may retain the obſerved difference of Latitude, and the Departure (found by the dead Reckoning) to find the Courſe and Diſtance, the error being imputed partly to the Courſe, and partly to the Diſtance. But once in two or three days, if it may be, obſerve carefully the Variation, which will give great light in your Eaſting and Weſting, as well as perfect your Courſe for its regular, and as orderly as any thing in the world can be to them that well obſerve it. If at any time it fail you, and you find a ſudden alteration of Variation ſuſpect your Compaſs, and look for the Iron that's about it.

Many neglecting the Obſervation of the Variation, by arguing from their reckonings, many times talk of Variation, where there's none, and ſometimes Eaſt-Variation, when indeed it's Weſt; and ſometimes tell us of no Variation, or a ſudden mutation, where there's a great Variation and very regular. Others again carrying an Azimuth Compaſs, and being skilled in obſerving the Variation, lay all errors in reckoning to Currents, making many hundreds more than are in being.

Of Currents, and how to allow for them in your Account.

If a Current ſet directly againſt a ſhip in her Courſe, it leſſens her diſtance ſailed by ſo much as is the drift or race of the Current in the ſame time.

If a Current run directly with the Courſe a ſhip ſails, it will augment her diſtance by ſo much as is the drift of the Current in the ſame time.

If a Current thwart the ſhips Courſe, it not only augments, or diminiſheth her diſtance, but makes her err in her Courſe, ſo that without knowing where they are (which I ſhall at the end of this Treatiſe ſhew how to find) and when found care taken to prevent the errors that would proceed from them, by allowing for them in the Reckoning, you may in ſailing to ſome ſmall lone Iſland, be at ſuch loſs, that you may not know which way to ſteer, as it has happened to ſeveral.

To avoid this, it's uſual now not to make directly towards ſuch Iſlands: but to get into the Latitude thereof while they are certain whether they be to the Eaſt or Weſt of it, and then keep in that Latitude, ſailing directly Eaſt or Weſt, according as the place lieth, 'till they get ſight thereof.

But to proceed, it's abſolutely neceſſary to know

know how to allow for the Currents upon any Rumb whatever, so that by observation of your Latitude you may by computation find your true Longitude.

To make a Plain Chart.

As to make a particular Chart for a Voyage between the Parallels of 43 deg. and 50 deg. North Latitude, and to contain 5 deg. of Longitude.

First, draw the Meridian, or North and South Line A B, and cross it at right Angles in the Point A, with another right Line A D, representing the Parallel of 43 deg.

Then taking any convenient length for a degree prick it seven times from A to B, marking them 43 44, 45, 46, &c. and five times from A to D, marking them 1, 23, &c. Through D, 4, 3, 2, &c, draw Parallels to A B for Meridians, and through B 50, 49, 48, &c. Parallels to A D, for Parallels of Latitude subdividing each degree both of the extreme Parallels and Meridians into 60, 30, 20, 10, or 12 equal parts as it will bear, in some convenient place depicting the Compass, with the Rumb-Lines drawn forth quite through the Chart.

To lay down a Place on the Chart.

Let A repreſent ſome place in the Latitude 43 degrees, and I would lay down another place that's 3 degrees, 30 minutes Eaſt thereof, and in Latitude 46 degrees 30 minutes North.

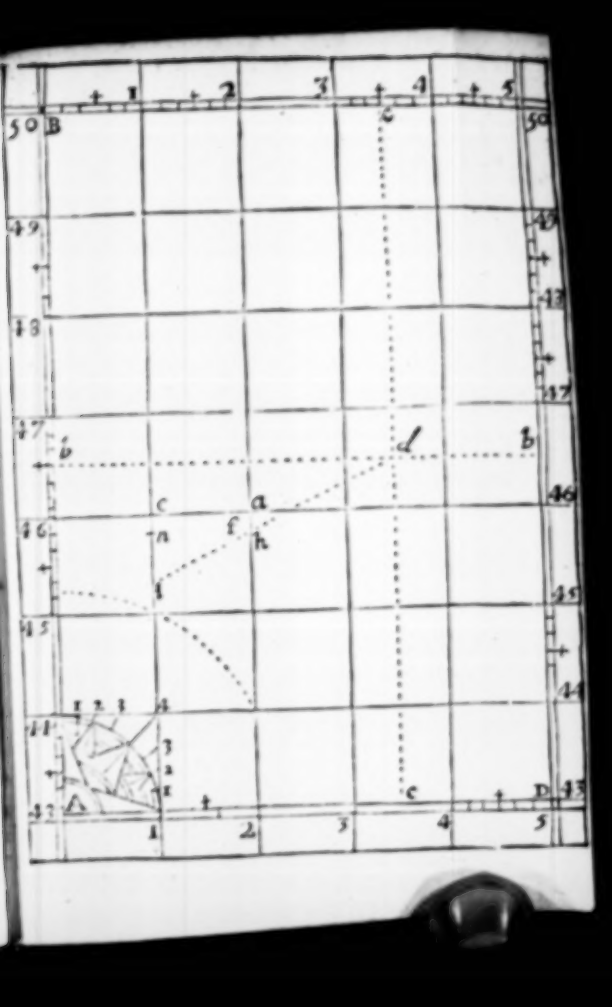
Firſt, laying a Rular over 46 degrees, 30 minutes of the extreme Meridians, draw the Parallel of 46 degrees 30 minutes, as b b, and laying it over 3 degrees 30 minutes of the extreme Parallels, draw the Meridian c c, and where this Meridian and Parallel croſs as at d, is the place required.

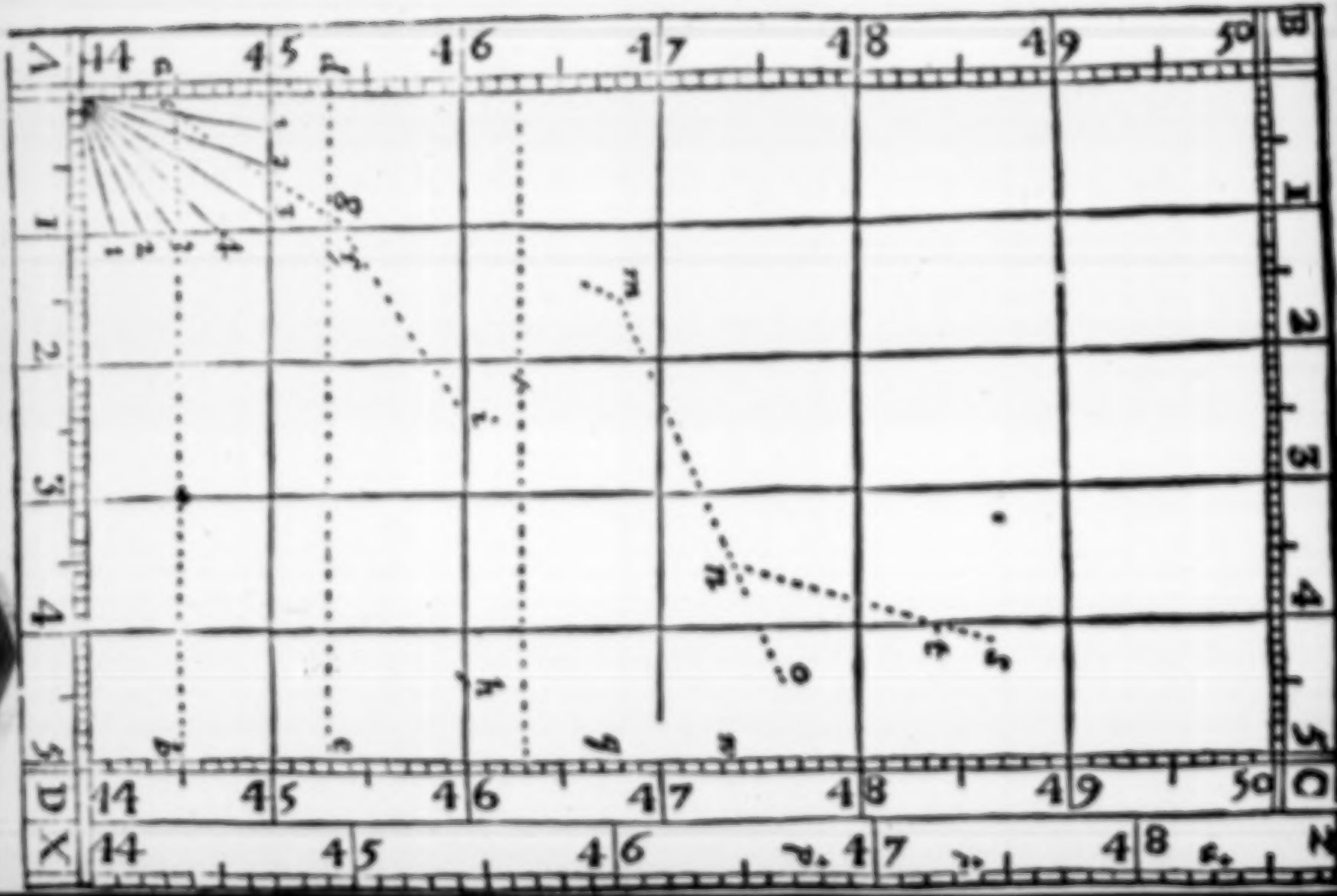
But if I had been to lay down the place d by a Courſe and Diſtance given: as ſuppoſe I know it ſhould lye N. E. from A, then from A I draw a Parallel to the N. E. Rumb Line, as A d, and taking 5 deg. or 300 m. from the Meridian Line, ſet it from A on the Line A d to d.

If I had been to lay it down by the Courſe and Latitude by a Rular over 46 deg. 30 min. of the extreme Meridians, I draw the Parallel of Latitude b b, and from A, a Parallel to the North Eaſt Rumb-Line, as A d, and where theſe cut one the other, as at d is the place.

But laſtly, if I had been to lay it down by the Latitude and Diſtance, I muſt have drawn the parallel b b as before, and then taking from the Meridian 6 d. or 300 m. the diſtance,

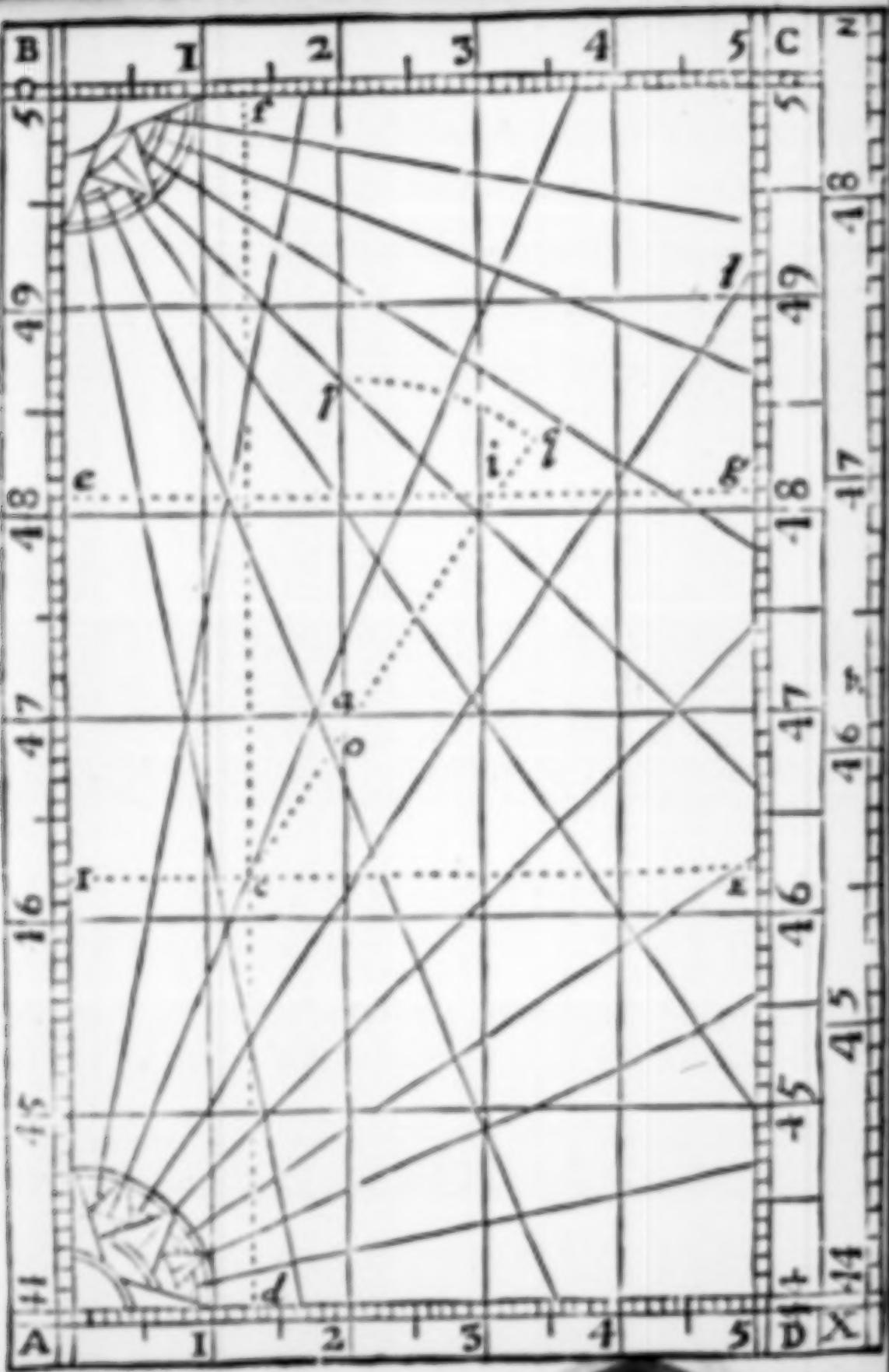
and

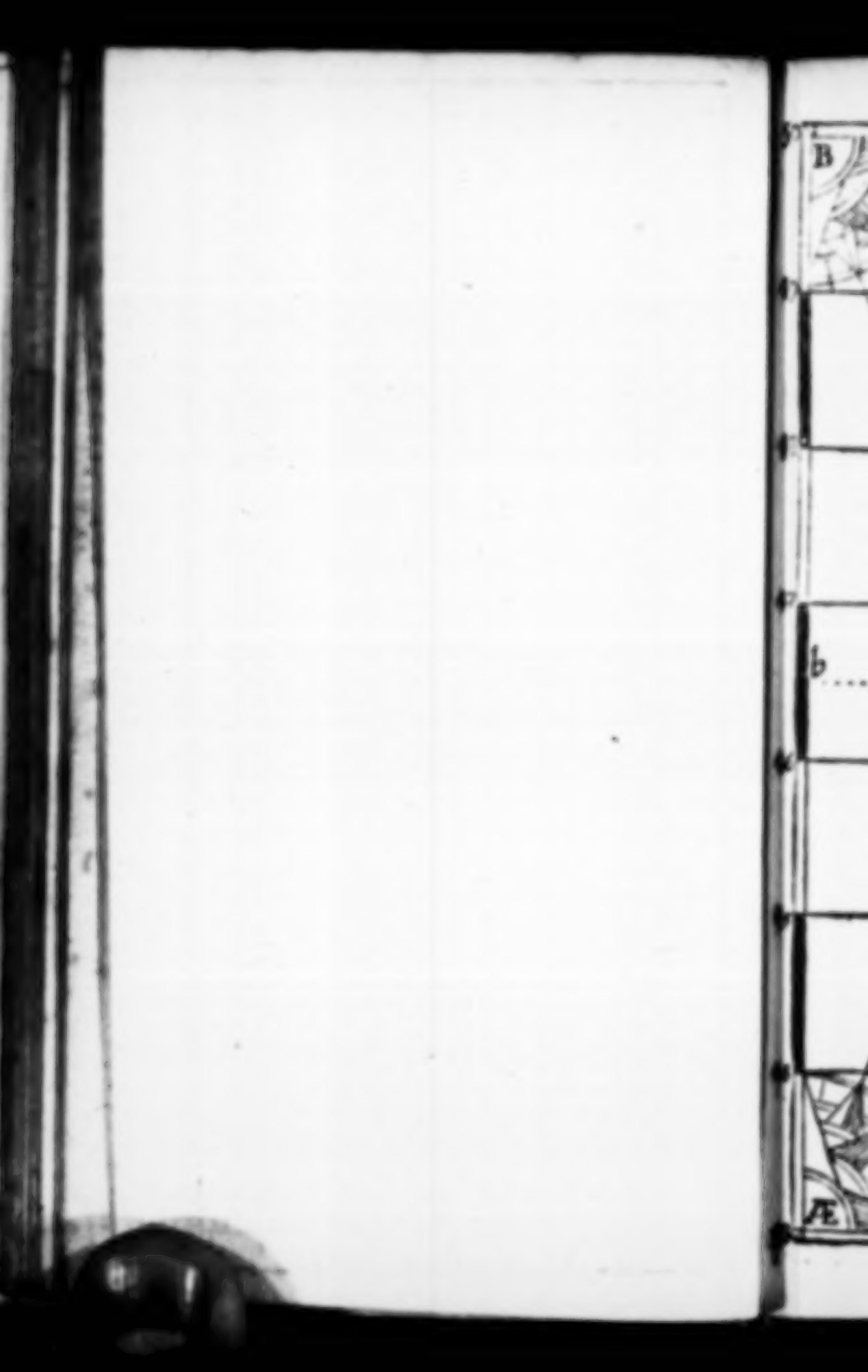

1
2
3
4
5
B
C
D
a
b
c
d
e
f
g
h
i
k
l
m
n
A

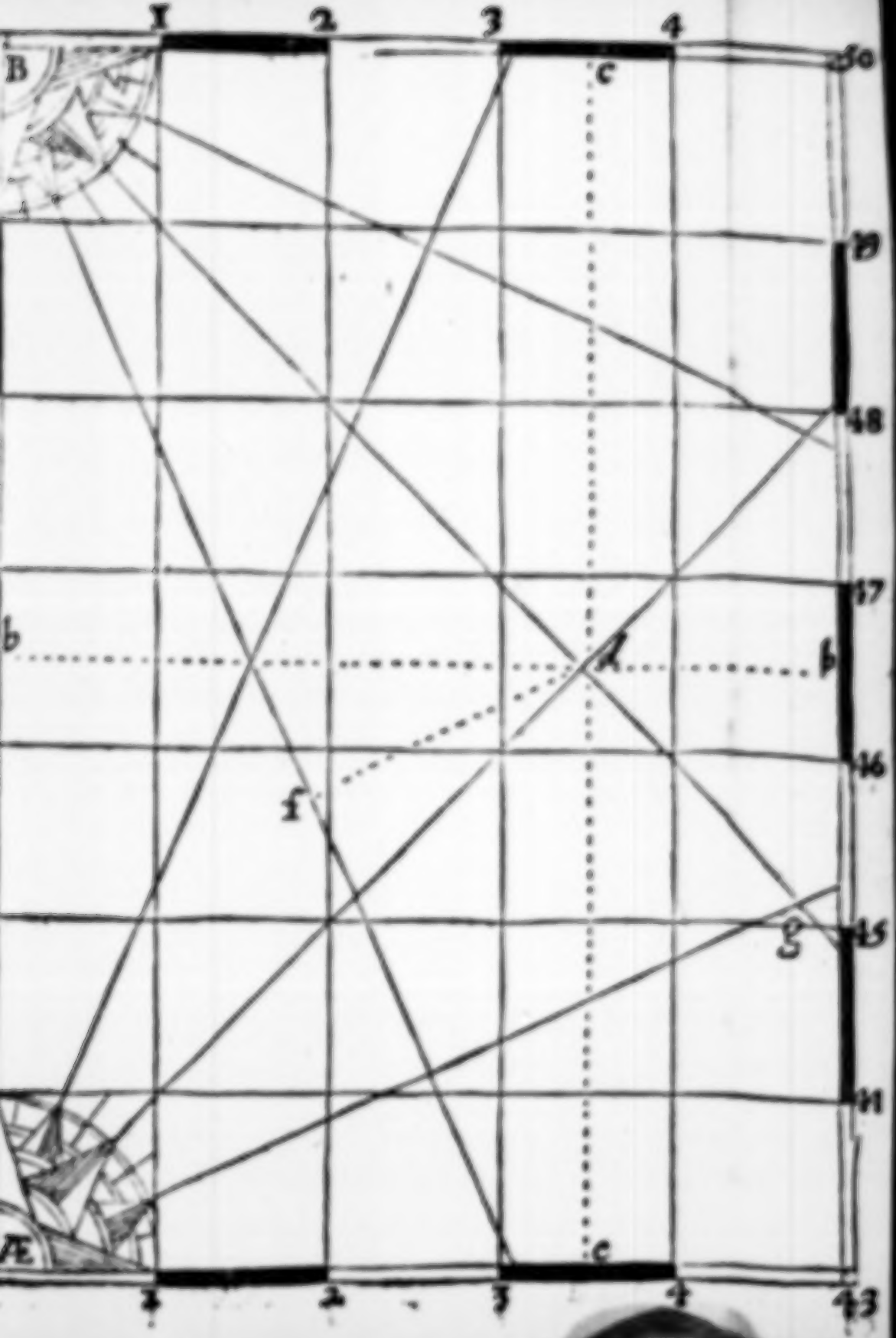

B
1
2
3
4
5
C
D
X
14
45
46
47
48
49
50

1

2


B
1
2
3
4
5
C
A
D
X
N
e
f
g
i
l
o
r
s
d


B
b
Æ


1
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3
4
B
C
50
49
48
17
b
b
16
f
g
15
11
Æ
c
2
2
3
4
43

and ſetting one foot in A, with the other make a prick on the parallel b b, as at d, which will be the place propoſed.

If the Rumb-Lines be not drawn on the Chart, you may prick down the Line A d, by ſetting one foot in A, as Center, and with 60 degrees of the Chords, deſcribing a blind Arch, &c. after the manner of the firſt and ſecond Caſe of Ch.

To find the Courſe and Diſtance between any two places on the Chart.

Laying a Rular over the two places, as d f, ſee what Rumb-Line runs parallel thereto, as A g, and that ſhews the Courſe, which from d to f is East North East. But if the Rumb-Lines be not drawn, only a Compaſs Card depicted on ſome part of the Chart, as in the ſecond draft, then laying the Rular over the places, ſee how it cuts the parallels of Latitude or Meridians, as in h and l, taking a h, ſet it from e to n, and taking n l, apply it to the ſide of the ſquare wherein the Compaſs is, and it ſhews the Courſe, two Points from the East nearly: then take the extent d f, and apply it to the ſcale, if there be one to the Chart, elſe apply it to the Meridian; and ſo many degrees as it's equal to, ſo many ſcore Leagues are the places diſtant, &c.

How

How to prick down a Voyage on the Chart by the Courſe and Diſtance, or make a prick for the ſhips place daily, needs no more inſtructions than what are already given at the beginning of this Ch. where I have delineated the Traverſe. I would adviſe all to keep their Reckoning or Account of the Voyage in number, daily correcting the dead Reckoning, and tabulizing the correct Eaſtings and Weſtings, Northings and Southings in particular Columns; and then if at any time a man be deſirous to make a prick for the ſhips place on his Chart, let him draw a parallel of Latitude, and a Meridian at his true Departure, and where they two cut will be the ſhips place.

CHAP.

CHAP III.

Oblique Triangles applied to Sailing.

1. COrſting along the ſhore, I ſet an Head-Land C bearing off me South South Weſt, I ſail Weſt South Weſt 51·5 miles to B, and then the Head-Land C bears South Eaſt from me: I demand my ſeveral diſtances to the Head-Land?



Geometry.

Taking any convenient Point, as A for the place of the ship, at first from thence draw a South South West Line, as A C, and a West South West Line, as A B, and on A B price 51'5 m. from A to B. Then setting one foot of

of the Compaſſes in B, with 60 degrees of the Chords, deſcribe the Arch e f, and lay thereon ſix points (the Points between East North East and South East) from e to f, drawing B F.

Arithmetick.

In the Triangle B A C is given the ſide B A 51·5 m. and all the Angles, *viz.* the Angle A. 45 deg. or 4 points between the Weſt South Weſt, and South South Weſt Points, and the Angle B between the East North East, and South East, 6 points, or 67 degrees, 30 minutes, and the Angle C between the North Weſt, and North North East, which is alſo 6 Points, to find the ſides B C and C A.

As the ſine of the Angle at the Head-land, 1 C	6 points	9,565615
Is to the diſtance run A B 51·5 miles.		1,711807
So is the Sine of the Angle at the firſt place of obſervation,	45 deg. 00 min. 1 A	9,849485
		11.561292
To the Diſtance B C 39·4		1,595677

After the ſame manner you may find the Diſtance thereof from the firſt place of Obſervation A, but in this Example for as much

as

as the Angles B and C are equal, the side A C will be concluded equal to E A 51·5, without another work.

2. *A Ship in the Parallel of 46 degrees North, as at B, descries an Head-Land at C, distant from her 67 miles; she sails East South East 63 miles to D, and then the Head-Land at C bears South West by West from her: how did the Head-Land bear from the ship when she was at B, and how far is it distant from her now she's at D?*



Geometry.

Geometry.

Taking any convenient point, as B for the place of the ship at first, from thence draw an East South East Line, and prick thereon 63 m. from B to D. Then on D as Center with 60 degrees of the Chords describe the Arch e f, and prick five points (the points between West North West, and South West by West) from e to f, drawing D f C. Lastly, take 67 m. in the Compasses, and setting one foot in E, with the other cross D C in C, and draw E C.

Arithmetick.

As the Distance B C 67 m.—1.825075

Is to the Sine of the Angle D 56 deg. 15 m. } 9,919846

So is the Distance sailed E D 63 m. } 1,799341

11,719187

To the Sine of the Angle C, 51 deg. 25 min. or } 9,893112

4 points and a half, which added to the Angle D, 56 deg. 15 min. and that sum taken from 180 degrees, the Remainder 72 degrees, 20 minutes, or 6 points and a half is the Angle E, which added to the East South East gives the

the bearing off G to be South half Westerly *first.*

Then as the Sine of the Angle B, 56 degrees; 15 minutes } 9,919845

Is to the Distance BC 67 m.---- 1,826071
So is a Angle B 72 deg. 19 m.---- 9,978980

11,805055

To the Distance DC 76 8---- 1,885209

3. *If*

If I sail South South west 50 miles, and then west by North 64 miles; I demand the Course and direct Distance from the place of Departure?



Geometry.

From A the Point taken for the ships place at first, draw the South South West Line, and lay thereon 50 m. from A to B. Then setting one foot of the Compasses in B, with sixty degrees of the Chord describe the semicircle d e b, and either prick 7 Points (the Point between South South West, and West by North) from d to e, or 9 Points from f to e, and through e draw B e, laying thereon 54 m. from B to C: lastly, draw A C.

Arithmetick.

In the Triangle C B A there's given the two sides C B, and B A, and the contained Angle, C B A, 9 points, to find the Angles A and C, and the third side C A.

Therefore, as C B + B A } 2,056981
11 4 m. ——— } ———
Is to C B - B A 14 ——— 1,146128
So is 1, half Angle C + Angle A, 1 39 deg. 23 m. } 9,914302
To the Tang. A C 5 deg. 45 m. } 11,050439 / 9,003125
Which substracted from 29 deg. 23 min. } Ang. C, 33 d. 31
There remains but 5 degrees. 45 m. added to 29 deg. 23 m. makes 545 deg. 8 m.

ngle A, wherefore seeing A D is a South uth West Line, A C is West South West rly, viz. West South West 8 m. Westerly.

Then for the Distance A C, say

s the Sine of the Angle A, 45 deg. 8 m. } 9,850493

s to the Dist. B C 64 m. —— 1,806180

o is the Sine of the Angle B 101 deg. 15 m. or rather it's Compl. to 180 d. viz. 78d. 45m. } 9,991574 / 11, 797754

To the Dist. A C 88·5 m. —— 1,947261

4. *Admit two Ports lying in the same Parallel or Latitude, differing in Longitude 58 miles, and a Ship having sailed from the Westermost between the South and East 65 miles, be then 45 miles from the Eastermost, I demand the course she steered, and her Course to the Eastermost Port?*



Geometry.

Having drawn an East and West Li
and laid thereon 58 m. from A to E, w
65 m. in the Compasses, and setting one fo
in A, with the other describe an Arch, af
wards take 46 m, and setting one foot in E
with the other cross the former Arch in C
Lastly, draw A C, and B C.

Arithmetick.

As A C 65 m. ——————— 1,812913

Is to A B + B C 104 —— 2,017033
So is A B-B C 12 ——— 1,079181

To A D 19·2 { 3,096214 / 1,283281

Which added to A C 65 is 84·2
The half whereof is 42·1 A F
Then as A E 58 m. ——————— 1,763428

Is to the Radius ——————— 10
So is A E 42·1 ——————— 1,624282

To the Cosine of the Angle A, 43 deg. 28 m. { 11,624282 / 9,860854

That is South East 1 deg. 32 min. Easterly, the Course she steered.

5. Cross

Coasting along the shore, I set two Head-Lands, the one at C, bearing S.W. by W. the other at D, bearing W. by W. I sail away N.W. by N. to H, 40 miles, and then the Head-Land at C bears S.S.W. and that at D S.W. by S. I demand how far those Head-Lands are asunder, and how they bear one off the other.



First draw a North and South Line, a
b A g, and with 60 degrees of the Chords, se
ting one foot on some convenient point for th
ships place at first, as A, describe the semicirc
b e g, (or a Circle if the Courses require it)
then prick thereon five points from g to f,
points from g to e, and 3 points from b t
c, and draw A f C, A D e, and A H c, layi
40m. from A to H.

Secondly, set one foot of the Compass
opened to 60 degrees of the Chords on H. an
describe the Arch a d, and prick thereon fo
Points (the Points between South East b
South, and South South West) from a to b
and 6 points (being the points between th
S. E. by S. and S. W. by S.) from a to d
and draw H h c, H D d, and D C. Then
D one Head-Land, and C the other.

Aritmetick.

In the Triangle H A C, there's given th
Angle H A C 8 Points (viz. the Points be
tween South West by West, and North We
by North) the Angle A H C 5 point
(between the South East by South, and Sou
South West) and the Angle A C A 3 Point
(the Points between the North East by Eas
and North North East) and the side H
40 m. to find the side C H. Therefore,

As the Sine of the Angle HCA 33 deg. 45 min. } 9,744739

Is to HA 40 m. —— 1,602060
So is the Sine of 90 deg. the Angle H A C —— } 10 ——

11,602060

To the side A C 72 m. —— 1,857321

Then in the Triangle D H A there's given the Angle H A D 6 Points (*viz.* the Points between the North West by North, and West by South) and the Angle A H D 6 Points (*viz.* the Points between the South East by South, and South West by South) and the Angle H D A 4 Points (between the North East by North, and East by North) and the side A H 40 m. to find the side D H. Thus

As the Sine of the Angle H D A 45 deg. 00 min. } 9,849485

Is to the side A H 40 m. 1,602060
So is the Sine of the Angle H A D 67 d. 30 m. } 9,965615

11,567675

To D H 52,3 —— 1,718190

Lastly in the Triangle D H C there's given the two sides C H 72 m. and D H 52,3 m. and their contained Angle C H D 1 Point, to find the other two Angles H D C, H C D, and the third side D C.

As HC † HD 124·3 —— 2094471

Is to HC——HD 19·7—— 1,294456
So is the Tang. Angle HDC } 11,005955
† HCD 7 points and a half, }
or 84 deg. 22 min —— } 12,300421
To the Tang. Angle HDC }
Ang. HCD 58 d. 6 m. } 10,205950

Which added to 84 d. 22 m. makes 142 d. 28 m. the Angle HDC, but ſubſtracted, leave 25 d. 16 m. the Angle HCD, which is North 1 quarter Weſterly, or N. 2 d. 45 m. Weſterly.

As the Sine of the Angle }
HCD 25 d. 16 m. } 9,630257

Is to DH 52·3 m. —— 1,718190
So is the Sine of the Angle }
DHC 11 d. 15 m. } 9,290236

11,008426

To DC 23·9 m. the Diſt. }
between the two Head-La. } 1,378169

CHAP.

CHAP IV.

Mercators Sailing.

THo the Plain Chart be very desirable for it's easiness, and very useful in short Voyages, and will serve in the longest Voyages, so a man return in or near the opposite Rumb he went by, as the Ancients, who being Coasters, did before the use of the Compass. Yet for as much as few places, or indeed none but such as lye under the same Meridian, or under the Equinoctial, can be therein expressed according to the true situation and distance one from another: but if they be laid down true by the Course and Distance, the Difference of Longitude will be false, if they be laid down by the Course and Difference of Longitude; then will the Distance and Difference of Latitude be more than it should be, and if they be laid down by their distance and difference of Longitude, which in many Cases is impossible, the Difference of Latitude will always be too little, and the Rumb too wide from the Meridian; and if they be laid down by their

Latitudes and Separation, then the Course will be wide, and the distance too much, &c. and the places in particular Maps or Charts being laid down in some one way, and in others another, and these Pieces many times rack'd together without due consideration of the differing methods places have been laid down by, the Geography and Hydrography of the World is so corrupted, that there are scarce extant any Descriptions of the whole, or large parts that are not notoriously erroneous, and the shape of the Lands much distorted: It were to be wished, that the world would not put over-much value thereon, nor use it in the laying down places, but by degrees, as much as may be, wean it self from the use of the Plain Chart, and by making the true Chart ease and familiar, bring it in request and use, seeing there is such a thing.

It was the great study of our Predecessors to contrive such a Chart in *Plano* with straight Lines, on which all, or any parts of the World might be truly set down according to their Longitudes, Latitudes, Bearings and Distances, a way was hinted almost two thousand years since by *Ptolomy*, and a general Map according thereto made in our preceding Age by *Mercator* (whence it's called *Mercator's* Chart) but the thing demonstrated, and a ready way shewed of describing it, was not till Mr. *Wright* about a hundred years since taught to inlarge the

the Meridian Line by the continual addition of Secants, so that all the degrees of Latitude might be proportional to those of Longitude, as on the Globe, which he has done after such an excellent manner, that in many respects it's far more convenient for the Navigators use than the Globe it self, and will truly shew the Course and Distance from place to place, which way soever a ship sails forth, or returns.

I shall shew to inlarge the Latitude both by the Meridional Parts and Artificial Tangents above 45 d. accounting every 30 m. to be one deg. and every minute to be two minutes of the Meridian Line, &c. which are in the same ratio, or hold the same proportion as the Meridional Parts made by the addition of Secants.

To find the Meridional Leagues or Minutes, answering to any Difference of Latitude. First by the Table of Meridional Parts.

Look the degrees of either Latitude by the Left Side, and the Minutes over head, and in the Angle of Meeting are the parts for that Latitude; so also look out the parts for the other; then if both Latitudes be of the same name, that is, both North, or both South, subtract these one from the other, and the Remainders are the Meridional miles, or minutes sought.

fought. But if there be minutes above ... tens, add a proportionable part of the diffe-rence which you find right against in the Right Hand Column under D.

	Mer. Parts.
Let one Lat. be 50 d. 20 m. N.	3505
And the other Lat. be 43 d. 15 m. N. which gives 2876770	2883
	622

The Meridional Miles between these two Latitudes: which, if divided by 3, gives the Meridional Leagues.

To find the Parts by the Table of Tangents.

Take half each of the given Latitudes, and to each half add 45 degrees, looking the Tangents of these Arks in the Table of Tangents, the difference of which Tangents divide by 379, and the Quotient shall be the Merid. Leagues required, or by 1263, and the Quotient shall be Merid. Minutes, or Miles.

Thus the half of 50 deg. 20 m. is 25 d. 10 m. which added to 45 deg. makes 70 deg. 10 min. the Tang. } 442879

wherein

whereof is the half of 43 d. 15 m. is 21 d. 37 m. and a half, which added to 45 d. makes 65 d. 37 m. and a half, the Tangent whereof omitting the Caracteriſt. is ——— 364294

379

The Merid. Leagues 207·3 as before.

78585
758

2785
2653

1320
1137

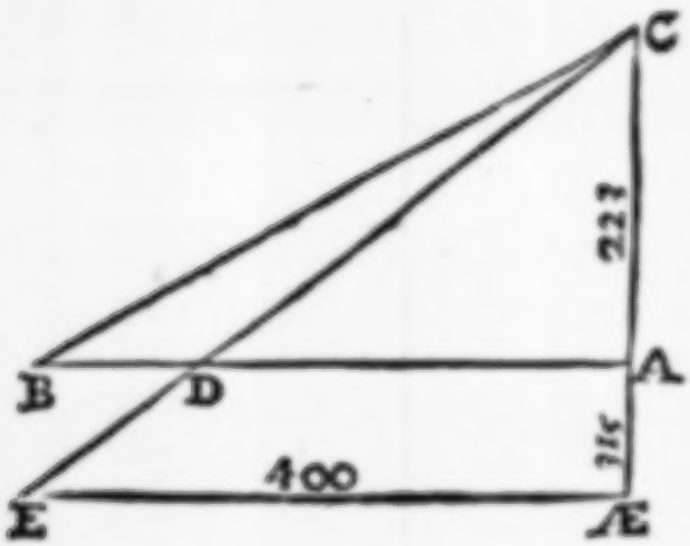
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CASE

CASE I.

The Latitudes and Difference of Longitudes of two Places given to find the Course and Distance.

Admit the Course and Distance between the *Lizard* in Lat. 50 deg. 10 min. and *Flores* (one of the *Azores* Isles in Lat. 39 deg. 00 min. N. whose difference of Longitude is 20 deg. be required.



Geometry.

Having drawn the Meridian Æ C, and laid 315 Leagues the Diff. Lat. inlarged from Æ to C, and on Æ raised a Perpendicular, prick 400 Leagues the Diff. of Long. from Æ to E, and draw C E, then prick 223 Leagues, the true Diff. Lat. from C to A, also on A raise a Perpendicular, as A E, pricking thereon 400 Leagues from A to E, and draw C B.

Then is C the *Lizard*, B *Flores*, according to the Plain Chart, E *Flores* according to the true Chart, C B the Distance between them on the Plain Chart, C E the inlarged Distance, and C D the true Distance, C B the Rumb-Line between them according to the plain Chart; C E the true Rumb-Line B C A is the Course according to the Plain Chart, and E C Æ the true *Mercator* Course, E Æ is the true Difference of Longitude, A D the true Meridian Distance or Departure.

Arithmetick.

Lat. 10 deg. 10 min.
Lat. 39 deg. 00 min.

The

The half is

25 deg. 5 min.
19 deg. 30 min.

Which added to 45 deg. makes

70 deg. 5 min.	The Tangents are	440583	
64 deg. 30 min.		321504	
	379)	119399	
		1137	
Diff. 315 Leagues		569	
The Lat. inlarged, C Æ.		399	
		1909	
		1895	
		14	

As the Difference of Latitude inlarged, C Æ. 315 Leagues	2,498311
is to the Radius	10,
So is the Difference of Longitude E. Æ. 400 Leagues	2,602060
To the Tangent of the true Course Angle E C Æ. 51d. 46m.	10,103749

Which sheweth the Course from the *Lizard* to *Ybas* to be S. W. 6 degrees, 46 min. Westerly

Westerly, or from *Flarts* to the *Lizard* North East 6 degrees, 46 minutes Easterly: but by measuring the Angle BC Æ you'll find the Course according to the Plain Chart South West about a quarter Westerly.

For the Distance.

As the Sine Compl. of the Course Col. Ang. E C Æ, 51 deg. 46 m. } 9,751596

Is to the Diff. of Lat. C A 223 Leagues } 2,348505
So is the Radius 10,

12,348505

To the true distance on the Rumb CD——360 5 Leag. } 2,556909

But by measuring B C you'll find the distance according to the Plain Chart 435, so that the Plain Chart sheweth the distance more than it is by 75 Leagues, and the Course more Westerly than the truth, by above half a point, and the Departure a great deal too much.

By the Gunter.

Set one foot of the Compasses in 315 on the Line of Numbers, and extend the other to 400; then keeping the same extent, set one

one foot on the Tangent of 45 deg. turning the other forward, and it will fall on 51 deg. 46 min. the Course.

For the Distance.

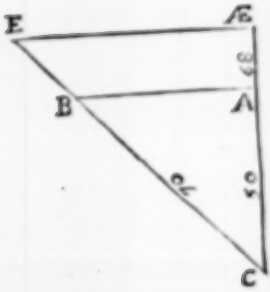
Set one foot in 38 deg. 14 min. of the Line of Sines, and extend the other to the Sine of ninety degrees, then keeping the same extent, set one foot in 223 of the Line of Numbers, and turn the other forward, and it will fall on 360 the Distance on the Rumb; there is a nearer passage between these two places, which is by the Arch of a great Circle.

This Proposition is first of use in a Voyage.

CASE II.

The Latitudes of two Places, and [illegible] given: to find the Course and Longitude.

A ship from the Latitude [illegible] deg. sails North Westward 30 Leagues, in the Lat. 44 deg. 00 min. what Course and Difference of Longitude.



Geometry.

Difference of Latitude, and
ineate according to the
ing, then produce the
lay 68 the Diffe-
C to Æ. Laſtly,
AB.

For

one foot on the Tangent of 45 deg. turning the other forward, and it will fall on 51 deg. 46 min. the Courſe.

For the Diſtance.

Set one foot in 38 deg. 14 min. of the Line of Sines, and extend the other to the Sine of ninety degrees, then keeping the ſame extent, ſet one foot in 223 of the Line of Numbers, and turn the other forward, and it will fall on 360 the Diſtance on the Rumb; there is a nearer paſſage between theſe two places, which is by the Arch of a great Circle.

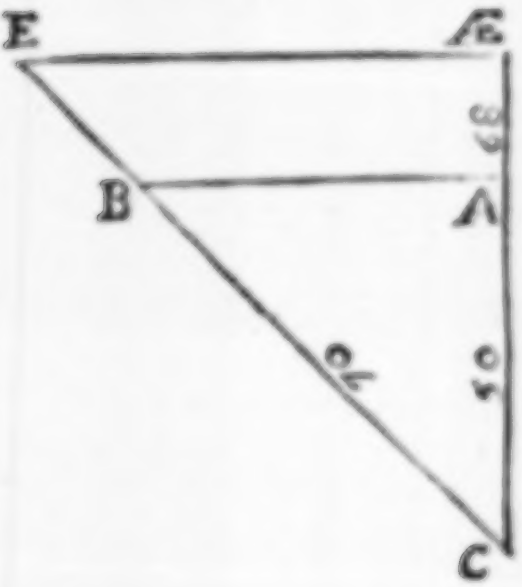
This Propoſition is firſt of uſe in a Voyage.

CASE II.

The Latitudes of two Places, and their Diſtance given: to find the Courſe and Difference of Longitude.

A ſhip from the Latitude 41 deg. 30 m. N. ſails North Weſtward 30 Leagues, till ſhe be in the Lat. 44 deg. 00 min. which was her Courſe and Difference of Longitude.

Geometry.



Geometry.

First, with the Difference of Latitude, and Distance given, delineate according to the third Case of Plain Sailing, then produce the Meridian and Rumb-Line, and lay 60 the Difference of Latitude inlarged from C to Æ. Lastly, through Æ draw Æ E parallel to A B.

For

For the Course.

Arithmetick.

As the Distance sailed, CB 70—— 1,845098

Is to the Radius———————— 10,——
So is the Differ. of the Latitude
C A 50 Leagues ———— } 1,698970

11,698970

To the Sine Compl. of the Course
Col. Ang. C. 44 deg. 25 m. —— } 9, 853872
That is North West, 35 min. Northerly.

For the Difference of Longitude.

First, find either by the Table of Merid. Parts, or the Tangents, the Meridional Leagues in the Difference of Lat. which are here 68: Then say,

As the Radius———————— 10, ————
Is to the Diff. of Lat. inlarged
C Æ. 68 Leagues ———— } 1,832509
So is the Tangent of the Course
t Ang. C 44 deg. 25 m. } 9, 991156

11,823665

To

To the difference of Longitude in Leagues *A. E.* 66-6.

Which Leagues being multiplied by 3, and the Product divided by 60, give 3 deg. 20 m. the Difference of Longitude, required.

By the Gunter.

He that hath well obſerved the manner of working all along hitherto by the Gunter, I cannot but ſuppoſe, will readily apprehend the working thereby of what follows, without any more Directions, and therefore I ſhall omit farther precepts for it, unleſs in ſome few uſeful Caſes.

CASE III.

Both Latitudes and the Courſe being given, to find the Diſtance and Difference of Longitude.

A ſhip from the Latitude 50 deg. 00 min. North. ſails South East by South till ſhe be in the Latitude 47 degrees, 54 minutes North, what will be her Diſtance run, and the Difference of Longitude?

Geometry.



Geometry.

Having drawn a Merid. Line C Æ. described an Arch, lay'd thereon the Course, drawn the Rumb-Line C Æ, and raised the Perpendicular B A according to the second Case of Plain Sailing, inlarge the Latitude, and lay the Difference of Latitude inlarged 63·8 from C to Æ, and on Æ raise the Perpendicular Æ E.

For

For the Distance.

Arithmetick.

As the Col. of the Course Ang. C 33 deg. 45 min.	9,919846
Is to the Diff. of Lat. CA 42 1	1,623249
So is the Radius	10,
	11,623249
To the Distance CE 50·5 1	1,703403

For the Difference of Longitude.

As the Radius	10,
Is to the Diff. of Lat. inlarged C Æ 63·8 Leagues.	1,804821
So is the Tang. of the Course Ang. C 33 deg. 45 min.	9,82489
	11,62971
To the Diff. of Long. ÆE 42·5 Leagues.	

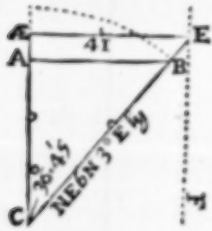
By these two Canons was made the third Traverse Table, which readily performs what's required in this Proposition.

CASE

CASE IV.

One Latitude, the Course and Distance of Longitude, being given, to find the other Latitude and the Distance.

Admit a ship sail from Latitude 32 deg.00 m. North, North East by North, 3 degrees Easterly, till she has altered her Longitude 2 degrees, 3 minutes, how much shall she have raised the Pole, and what is her distance sailed?



Geometry.

Having drawn the Meridian C Æ, described an Arch, pricked thereon the Course, and drawn

drawn the Rumb-Line C E, at the extent 41 of the equal parts, or Leagues, draw a parallel to the Meridian C Æ as F E; and from the point E let fall a Perpendicular to C Æ, as E Æ; then add to the measure of C Æ 54·9 the difference of Latitude inlarged, the Meridional Leagues for 32 deg. 00 min. of Latitude, and the triple Sum looked in the Table of Meridional Parts, gives 34 deg. 22 min. the Latitude she's arrived in: Lastly, substract these Latitudes one from the other, and the difference turned into Leagues, prick from C to A, through A, drawing A B parallel to Æ E.

For the Difference of Latitude.

Arithmetick.

As the Tangent of the Course Ang. C 36 d. 49 m.	9,873167
Is to the difference of Longit. E Æ. 41 Leag.	1,612784
So is the Radius	10
	11,612784
To the Diff. of Lat. inlarged C Æ 54·6 Leagues	1,735617
The Merid. Leagues answering to 32 deg. 00 min. of Lat. are	676 0
To which add.	54 0
The Sum	730·9
Its Triple	2192·7

Against which in the Table of Meridional Parts is Lat. 34 deg. 22 min.

For the Distance.

As the Cosine of the Course 36 deg. 45 min.	9,909379
Is to the true diff. of Lat C A 47 ¾ Leagues	1,674861
So is the Radius	10
	11,674861
To the distance C B 59	1,771561

CASE V.

The Course and Distance and one Latitude being given, to find the other Latitude and the difference of Longitude.



Geometry.

A Ship from Latitude 53 degrees, 30 minutes North, sails South West by South 60 Leagues, I demand the Latitude she's in, and the Difference of Longitude. I protract the

Course and Distance according to Case I, of Plain Sailing and measuring the Difference of Latitude C A, I find it 49·9 Leagues, which I convert into degrees, by dividing by 22. This 2 deg. 30 min. the difference of Latitude, because she depresses the Pole, I subtract from Lat. 53 deg. 30 min, and the remainder 51 deg. 00 min. is the Latitude she arrived in. Then either by the Table of Meridional Parts, or that of Tangents, I find the inlarged Difference of Latitude as formerly directed, and prick that, *viz.* 81·6 from C to Æ. Lastly, on Æ I raise a Perpendicular to C Æ as Æ E, and produce the Rumb-Line C B till it meets with Æ E.

Arithmatick.

For the Difference of Latitude.

As the Radius	10
Is to the Distance sailed C B 60 Leagues.	1,778151
So is the Cosine of the Course Angle C, 33 deg. 45 min.	9,919846
	11,697997
To the Difference of Latitude C A 49·9 Leagues.	1,697997

which converted into degrees, is 2 deg. 30 min. *fere*, the Difference of Latitude, which substracted from 53 deg. 30 min, leaves 51 deg. 00 min. the Latitude required. The Difference of which two Latitudes inlarged is 81·6 Leagues.

For the Difference of Longitude.

As the Radius ——— 10 ———	
81·6 Difference of Latit. inlarged C Æ 81·6 ———	1,911690
So is the Tangent of the Course 2. Angle C 33 deg. 45 min.	9,824892
	11,736582
To the Difference of Longit. Æ E 54·5 Leagues, which divided by 20, or multiplied first by 3, and then divided by 60,	1,736582

makes 2 deg. 43 min. and a half.

By the Gunter.

For the Difference of Latitude.

Set one foot in the Sine of 90 deg. and extend the other to the Sine of 56 deg. 15 min. then keeping the same extent, set one foot in 60 on the Line of Numbers, and the other

turned backward, will fall on 409 Leagues, the Difference of Latitude, which converted into degrees, is 2 deg. 30 min. which 2 deg. 30 min. because she depresses the Pole, subtract from 53 deg. 30 min. and the Remainder 51 deg. 00 min is. the Latitude the ships in. The Difference of which two Latitude inlarged is 81·6.

For the Difference of Longitude.

Set one foot of the Compasses in the Tangent of 45 deg. 00 min, and extend the other to the Tangent of 53 degrees, 45 minutes, then keeping the same extent, set one foot on 81·6 on the Line of Numbers, and turn the other foot backward, and it will fall on 141 Leagues, the Difference of Longitude

There be several other Propositions of *Meretor's* Sailing: as

6. *By the one Latitude, Distance, Rumb and Departure, to find the Course, Latitude the Ships in, and the Difference of Longitude.*

7. *By the Departure and both Latitudes given to find the Distance run, Difference of Longitude and Course.*

8. *The Course, one Latitude, and the Departure given, to find the Distance, Difference of Latitude, and Difference of Longitude.*

But these being of no great use, I shall omit them, and insert two or three Propo-

tion

tions of Sailing, under a Parallel of Latitude.

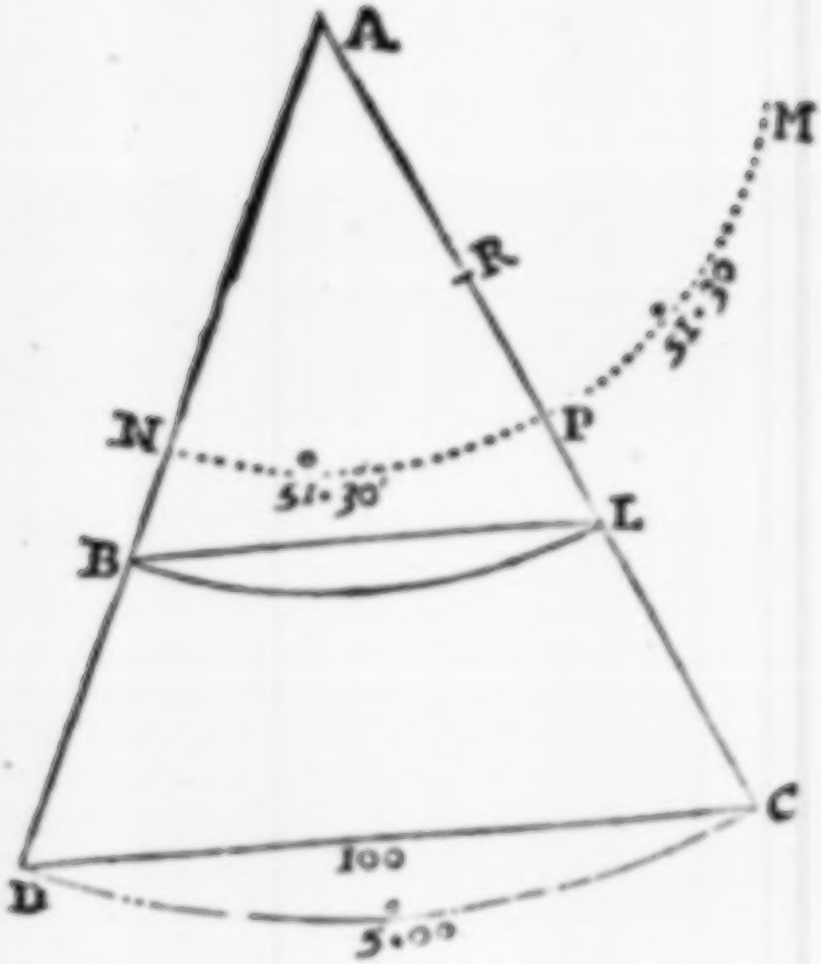
3. *The Difference of Longitude between two places lying in one Parallel or Latitude being given, to find the Distance between them.*

If a Ship ſail in the Latitude 51 deg. 30 min. till her Difference of Longitude be 5 d. com. what will be her diſtance run?

Geometry.

Firſt draw a ſtraight Line, as A C, and ſetting one foot of the Compaſſes in A, with 60 degrees of the Chords, deſcribe the Arch N P M, and prick thereon 51 deg. 30 min. the Latitude from P both ways to N and M; then laying a Rular from M to N, croſs the Line A P in R; afterwards prick A R from R to L, that is, double A R, and alſo A P, and deſcribe the Arches L E, C D.

Laſtly, taking 100 Leagues from the Line of equal parts, prick it from C to D, and draw C D, and D A and E L: then is A the Pole, A C and A D two Meridians, D C an Arch of the Equinoctial, E L an Arch of the Parallel of 51 deg. 30 min. Lat. A R is the Coſine of the Latitude, A L = A R deſcribed, A C = A P doubled. A R and A P are ſtudied but of neceſſity: for the hundred Leagues



Difference of Longitude might have been layed on the Arch P N, and the Distance measured by an Arch described in A R; but for conveniency that our Line of equal parts might serve, without doubling, halving, or taking a new Line.

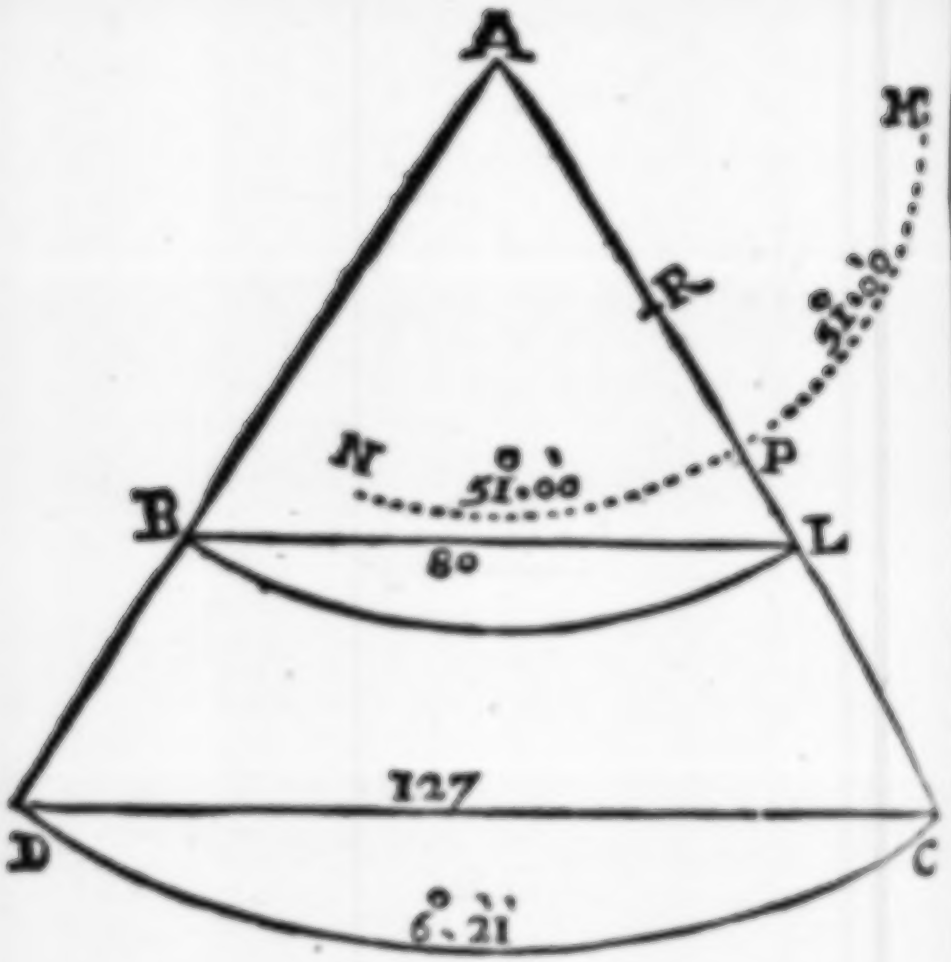
Arithmetical

Arithmetick.

As the Radius or Sine of 90 deg. A C	10
Is to the Cosine of the Latitude 51 deg. 30 min. A L	9,794149
So is the Difference of Longit. D C 5 deg. or 100 Leagues	2,000000
	11,794149
To the Distance in the Parallel B L 62·3 Leagues.	1,794149

2. *A Distance in any Parallel of Latitude being given, to find the Difference of Longitude.*

If a Ship sail 80 Leagues East or West in the Latitude 51 deg. 00 min. what will be her Difference of Longitude?



Geometry.

Having drawn the Meridian A C, and with 60 degrees of the Chords described the Arch N M, and pricked the Latitude from P both ways to N and M, made the mark R, doubled A R, and A P, and described the Arches C D, and

and L E, as in the last Proposition; take 80 Leagues from the Line of equal parts, and prick from L to E, and draw E L and D C.

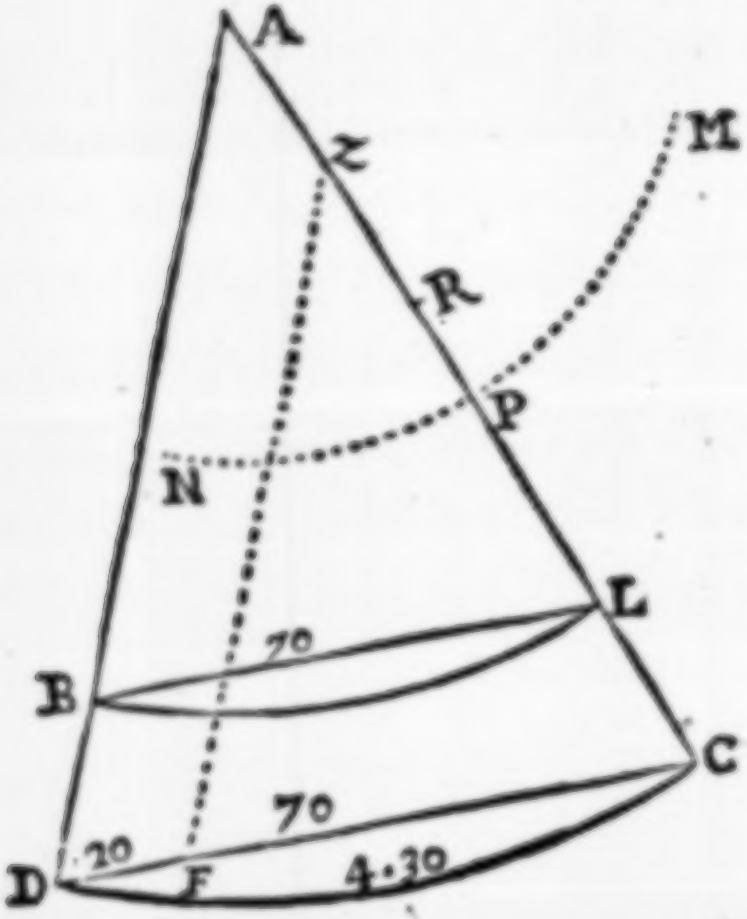
Arithmetick.

As the Cosine of the Latitude 51 deg. 00 min A L	9.798872
Is to the Radius or Sine of 90 deg. A C	10.000000
So is the Distance sailed E L 80 Leagues	1.903090
	11.903090
To the Difference of Longitude D C 117 Leagues	2.104218

which turned into degrees, is 6 deg. 21 min.

3. *The Distance sailed under any Parallel, and the Difference of Longitude being given, to find the Parallel or Latitude.*

If a ship sail East or West 70 Leagues, and thereby make her Difference of Longitude 4 deg. 30 min. what is the Parallel or Latitude she has sailed under?



Geometry.

Having drawn the Meridian A C, and with 60 degrees of the Chords described the Arch N M, and with A C (the double of A P) described the Arch D C, and laid 90 Leagues the Difference of Longitude, from C to D, and drawn D C, A D, prick 70 Leagues, the Distance on C D from C to F, and through F draw a parallel to D A, as F Z, then with Z C as Radius setting one foot of the Compasses in A, with the other describe the Arch E L: Lastly, bisect A L with a Line at right Angles thereto, as N M; then is the Arch P N or P M cut off by this Line, equal to the Latitude.

Arithmetick.

As the part of the Equinoctial C D 90 Leagues, the Difference of Longitude	1,954242
Is to the Semidiameter of the Equinoctial C A the R or s. 90 deg.	10,——

So

So is that part of the Parallel LB 70 Leagues, the Diſtance ſailed ——— } 1,845098

11,845098

To the Semidiameter of the Parallel A B, the Coſine of the Latitude ——— } 9,890856

And the Latitude is 38 deg. 57 min.

There be ſeveral other of this kind, as

Admit two ſhips under the Equinoctial, and 100 Leagues diſtant aſunder, and they ſail both directly North 550 Leagues, how far will they then be aſunder?

Two ſhips in Latitude 50 degrees, 40 minutes North, diſtant 50 Leagues one from the other, and they ſail both directly North 700 Leagues, it's required how far they ſhall be then diſtant aſunder both in degrees of Longitude and Leagues.

CHAP.

CHAP V.

To make a Mercators Chart.

THe Chart may be made either general for the whole World, or particular, for ſome certain part thereof.

He that underſtands the making of the one cannot be ignorant how to proceed for the other: therefore I ſhall only ſhew, *To deſcribe a Particular Chart* for ſome certain numbers of Degrees of Longitude and Latitude, more or leſs, according as a Voyage ſhall require.

Let it be required to graduate a Chart for a Voyage between the Parallels of 44 deg. and 50 min. of Latitude, and to contain 5 min. of Longitude.

Firſt, draw the North and South Line A B, and croſs it at right Angles in the point A with another right Line A D, repreſenting the Parallel of 44 Degrees. Then taking 60 from any Line of equal parts, or Diagonal Scale, prick it on A D five times from A to D, for the five Degrees of Longitude, marking them 1, 2, 3, &c. as in the Draft, ſubdividing each of theſe Degrees into ten equal parts, which will

will be ſix minutes each, and afterwards through A draw A B parallel to D C.

Secondly, look in the Table of Meridional Parts, for the parts anſwering to both Latitudes,

Againſt { 50 deg. / 44 deg. } are { 3474 / 2945 }

529 the dif.

The difference of theſe Numbers anſwering to both Latitudes, *viz.* 52·9 miles, take from the Diagonal Scale, and prick on the Meridians from A to B, and from D to C, and draw B C the Parallel of 50 degrees of Latitude; ſo are both the extreme Meridians and Parallels drawn.

Thirdly, through 1, 2, 3, 4, *&c.* of the Line A D draw parallels to A B, which will be the Meridians of the Chart. Now if you have a Meridian Line anſwerable to the equal parts uſed, as there is on the Gunter's Scale, it's but tranſferring the Diviſions thereof to the Meridian A B, either by laying the edge of the Scale that has the Meridian Line graduated on, to the Meridian A B, or taking them with the Compaſſes, *&c.* and through theſe points 45 deg. 46 deg. 47 deg. *&c.* of the Meridian A B, drawing parallels to A D, and the Chart's completely graduated.

Elſe taking out of the Table of Meridional

Parts

Parts the Numbers for Latitude 41 deg. and any other grad. you have a mind to prick down, and ſubſtract them one from the other, and the Difference taken from the Diagonal Scale, lay from A upwards.

Thus the parts for { 47 deg. / 44 deg. } are { 3202 / 2945 / 257 Diff.

The Difference 257 prick from A to 47 deg. ſo proceeding for the reſt, even the ſubdiviſions alſo.

If the two extreme Latitudes be one South, and the other North, and not both in one Hemiſphere, then add the Meridional Parts of both Latitudes together, and the ſum pricked on the North and South Line gives the length of the Chart. You may deſcribe a Compaſs in ſome convenient place, and draw the Rumb-Lines as in the firſt draught.

Laſtly on the outſide of DC make another Line of equal parts XZ, whereof each degree may be twice as large as a degree of Longitude, and divide and graduate it, as you ſee in the Draught: I ſhall call this Line the *Aſſiſtant*.

Sometimes you muſt uſe the Line AD as a Line of Leagues, and then will this *Aſſiſtant Line* be of uſe, and not elſe.

To

To lay down a place, or make a prick on the Chart.

To lay down a place by the Course and Distance.

Admit you have ſailed from A, a place in Latitude 44 deg. North, 48 Leagues North North Weſt, and it be required, to prick the place the ſhip is in.

Take 48 Leagues out of the Line of Longitudes A D, and enter it on the ſecond Rumb, or North North Weſt Line from A to a, the neareſt Diſtance from a to AD prick in the *Aſſiſtant-Line* from X to b, and it ſhews that the ſhip is now in Latitude 46 deg. 14 min. to which Latitude look on the Meridian AB, ſet the Letter I.

Secondly, through the point I draw the parallel of Latitude IE, and where that cuts the Rumb Line, as at c, is the place the ſhip is in.

To lay down a place by its Latitude and Longitude.

Draw a *Meridian-Line* at the Longitude of the place given, and a parallel of Latitude at the Latitude given, and the point where this Meridian and Parallel croſs, or cut, is the prick repreſenting the place.

By the Course and Latitude to lay down a place, or make a prick.

Admit from G a place in Latitude 46 deg. 4 min. I sail North West by North, till I am in Latitude 48 deg. 6 min. and would prick the place of the ship. Through 48 deg. 6 m. I draw the parallel of Latitude e g, and through C I draw a parallel to the North West by North Rumb Line, as c i, and where that cuts the parallel e g, as at i, is the ships place. What has been done thus by drawing Lines, may be performed by the intersection of two small Arches, or Lines and a Rular, without drawing long Lines: for a Rular will supply Lines without drawing them.

To find the Latitude, Longitude, Course and Distance between any two places already laid down in the Chart.

To find the Latitude.

Take with the Compasses the neareſt Distance between the given place c, and some parallel of Latitude, as A D; then setting one foot of the Compasses on the end of the parallel, as at A apply that extent to the graduated Meridian, the right way (*viz.* that way that the

the place lyeth from the parallel) and the other foot will ſhew as at I, the Latitude of the place.

To meaſure the Longitude, or rather Difference of Longitude.

Take with the Compaſſes the neareſt Diſtance between the given place c and ſome Meridian as AE; then ſetting one foot on the end of the Meridian A, apply the extent to the graduated parallel, and the other foot will ſhew the Difference of Longitude.

To find the Courſe between any two places in the Chart.

Lay a Rular over the two places, as c i, ſee what Rumb-Line runs parallel thereto, as A l, and that ſhews the Courſe: But if the Rumb-Lines be not drawn, take 60 deg. from the Chords, and ſetting one foot in O, where the Rular cuts ſome Meridian, deſcribe the obſcure Arch p q, which meaſured on the Line of Rumbs on your Scale, ſhews the Courſe three points from the Meridian, *viz.* North Weſt by North.

To measure the Distance between two places.

If the two places differ only in Latitude, the Difference of Latitude is the Distance between them. If the two places are both in the same Latitude, take the Distance between them, and apply the Compasses to the graduated Meridian, one foot standing as much above the Latitude, as the other below, the Degrees intercepted is the Distance, or rather thus, take a Degree of the Meridian at that Latitude, and turn it between the two places by a straight Line, and so often as you shall find that length between the two places, so many score Leagues is the distance between them.

If the two places differ both in Latitude and Longitude, take the difference of Latitude between them in degrees from the Line AD, and laying a Rular upon the two places, apply one point of the Compasses so to the edge of the Rular, that the other turned about may just touch some East or West Line crossed by the Rular; then take the distance by the edge of the Rular, from the place where the Compasses rested, to the place where the Rular crosses the said East and West Line, that extent measured on the Line AD, shews the Degrees or Scores of Leagues between the two places.

To

To keep a Mercator-Account of the Ships place daily by the observed Latitude, and the Course.

Admit a Ship sail from A, a place in Latitude North 44 deg. 00 min. North by West: till she's arrived in the Latitude 44 deg. 30 m. and from thence North West by North till in the Latitude 45 deg. 18 min. and afterwards North West by West till she fall in Latitude 46 deg. what's the difference of Longitude, and also the Course and Distance made good from the first place of Departure?

First draw the parallel of 44 deg. 30 min. Latitude, where it cuts the North by West, or first Rumb-Line from the Meridian, as at c, is her place on that Rumb, then draw the parallel of 45 deg. 18 min. Latitude d e, and continue the North West by North, or third Rumb Line, till it cuts it in f; then through c draw a parallel to the Rumb Line A f as c g, the point g where it cuts the Parallel of Latitude is the ship at the end of her North West by North Course.

Thirdly, draw the parallel of 46 deg. and continue the North West by West Rumb Line, till it cut it in h, and through g draw a parallel to A h as g i, so is i her place at last: now taking i k, and applying it to A D. you'll find she's 2 deg. 20 min. Longitude West from A; and by laying a Rular over A and i, you will

will find by comparing it with the Rumb-Lines she has made a North West by North half Westerly Course, or better, &c.

Arithmetick.

It may be performed by the third Case, or Proposition of Mercators Sailing.

This way of keeping an account of a Voyage is not contemptible in parts where there is a certainty of a clear Heaven to observe in, so that care be taken still to rectifie the Compass, keep her steered steady, Leeway allowed for, and the Currents tryed once a day, all which trouble is sufficiently recompensed in the omitting the continual keeping an account of the Distance.

But it is objected, that because there's no way of examining, or discovering whether any error be in their account or not, unless some small glimpse from the Variation, and if discovered, yet here's no way of correcting it, until some way be found for observing the Longitude (after which this will be the best and only way) it's not a safe method to rely on.

To which I answer, that if an account of the ships way be kept, also the correction may be made by that: but then it will be better to keep the whole account by her Course and Distance and correct by the observed Latitude, like as

in

in *Plain Sailing*: and as it doth follow.

To keep a true account of the ships place daily, by her Course and Distance.

Admit a ship sail from A in Latitude 44 deg. 00 min. North, North North West 60 Leagues, or 180 miles, then West North West 30 Leagues, or 90 miles: Afterwards North by West half Westerly, 20 Leagues, or 60 miles: and it be demanded what Latitude she's in, the Difference of Longitude, and the Course and Distance she has made good?

Taking 60 Leagues from the Line AD, prick them on the North North West Line from A to m, and taking the neareſt Diſtance to AD, and applying it to the Line X Z, you'll find she's in the Latitude 46 deg. 48 min. then drawing the parallel of 46 deg. 48 min. Latitude, and producing the North North West Line, they will meet in m the first point.

Secondly, through m draw a parallel to the West North West Line, as m n, and lay thereon 30 Leagues from m to o, and taking the neareſt Diſtance from o to the parallel 46 deg. 48 min. Latitude m q. set it on the Aſſiſtant Line from p to r, which shews you are now in Latitude 47 deg. 22 min. and drawing the parallel of 42 deg. 22 min. Latitude, where it cuts m o as at n, is her place

on

the Chart at the end of the ſecond Courſe.
Thirdly, through n draw a parallel to the
North by Weſt half Weſterly Rumb-Line, and
pick thereon 20 Leagues from North to South,
and taking the neareſt diſtance from South to
North Weſt, the parallel of 42 deg. 22 min.
Latitude, apply it to the Aſſiſtant Line, from
t to u, which will ſhew the Latitude now to
be 48 deg. 20 min. Laſtly, draw the paral-
lel of 48 deg. 20 min. and where it cuts n s
as at t, is the ſhips place at the end of this
third Courſe. Thus muſt they be proceeded
with if more. Now find the Longitude of the
point t by the former Directions, and alſo
the Courſe and Diſtance made good from A.

CHAP. VI.

Of Obſervation, and the Uſe of Inſtruments.

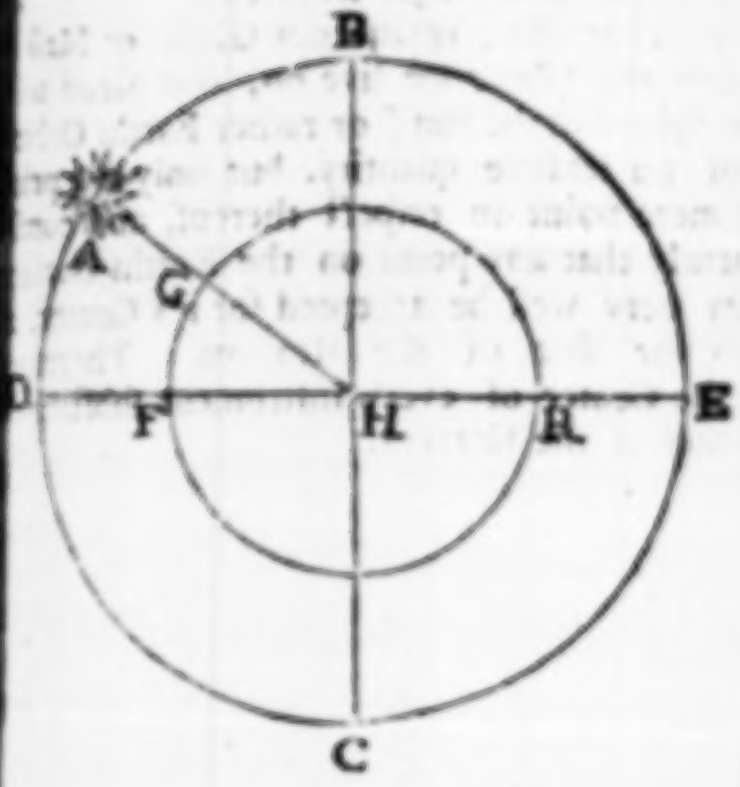
THis Art of Traverſing and Caravanning over *Neptune*'s vaſt Dominions, is not a ſimple or ſingle Science; but a Complication of the three moſt noble Sciences, *Arithmatick*,

Geometry, and *Astronomy*. It makes use of A
rithmetick for Computation; Geometry
Delineation and Demonstration; and As
nomy for Observation: which is clearly e
pressed in his Majesties *Silver Badge* worn
the *Blew-Coat-Children* of the *Royal Founda*
in *Christ's Hospital*, whereon are three Wom
for these three Scienees.

The first of these with the Table of Nu
bers is Arithmetick: the second with the Tr
angle is Geometry: and the third with th
Forestaff Astronomy.

Thus far having dealt with the two fir
without the third, here I shall handle the thi
yet not without the two first (it being impo
sible) neither here shall I meddle with mu
of Astronomy; but only so much as immed
arely and directly tends to Navigation, a
Nautical Observation.

A Co



A Coelestial Observation is founded on these
o Principles.

1. That when many Circles are concentrick,
e Lines drawn from their Center to the Cir-
nferences, divide them all in the same man-
r, as in Example.

If the Circles D B E, F G R be described
m the same Center H, and the Lines H F D,
G A drawn, the Arches D A, F G shall be

like parts of their Circumferences, and c
tain a like number of Degrees.

2. That the Terraqueous Globe or Mas
Earth and Water we live on, compared w
the Sphere of the Sun (or rather Earths Orb
is of no ſenſible quantity, but only as a pr
or meere point in reſpect thereof, and con
quently that any point on the Earths Surfa
may very well be accepted for it's Center,
alſo for that of the Heavens. Therefo
is the Center of every Inſtrument ſubſtitu
Center of the Heavens.

The Figure of the Fore-staff.



The Description and Use of the Fore-staff, or Cross staff.

It consists of a straight square graduated Staff, and four Crosses or Vanes: the first and shortest

is called the *Tin Crofs or Vane*, and belong
that fide of the ſtaff where the Diviſion
gin at about three degrees, proceeding tow
the Eye (or flat) end to ten degrees: ſo
times the Thirty Croſs is ſo made, as that
breadth thereof ſerves inſtead of this Tin-C
The next longer is called the *Thirty-Croſs*,
belongs to that ſide of the ſtaff where the
viſions begin at ten degrees, and end at thi
degrees; and this is called the Thirty-ſi
half the length of the Thirty-Vane will rea
on this Thirty-ſide from 30 deg. to 23 deg.
min. and the whole length from 30 deg. to
47 min.

The next longer is called the Sixty-Cro
and belongs to that ſide where the diviſion
begin at 20 deg. and end at 60, and is call
the ſixty-ſide. The length of this Croſs w
reach on this ſixty-ſide from 60 deg. to
30 deg.

The longeſt Croſs is called the Ninety-Cro
and belongs to that ſide where the diviſions be
gin at 30, and end at 90, and is called th
ninety ſide of the ſtaff.

Sometimes the ſeveral ſides of the ſtaff a
numbered alſo with their Complements to 9
in ſmall Figures.

The uſe of the Fore-ſtaff.

The chief Uſe is either to take the Altitud

of the Sun or Stars, or the distance of two Stars, and the Ten, Thirty, Sixty and Ninety Crosses are to be used according as the Altitude or Distance is greater or lesser, that is, if it be less than ten degrees use the Ten Cross; if less than thirty degrees, the Thirty Cross; if less than sixty degrees, the Sixty Cross: above which it is not so convenient for use as other Instruments.

To observe an Altitude.

Place the flat end of the staff to the outside of your eye, as near as you can, not to hinder your sight, and look at the upper end of the Cross for the Center of the Sun, or Star, and at the lower end for the Horizon: but if you see the Sky instead of the Horizon, draw the Cross a little nearer to your Eye; but if you see the Sea instead of the Horizon, put the Cross a little further from your Eye, and so continue moving and removing the Cross till you see exactly the Sun or Stars center by the top of the Cross, and the Horizon by the lower end thereof. The degrees and minutes cut by the minor edge of the Cross, upon the side of the staff peculiar to the Cross you use, is the present Altitude of the Sun or Star: but if it be the Meridian or greatest Altitude which you are to find, you must continue your Observation as long as you find the Altitude in-

creaſe, ſtill drawing the Croſs nearer to your Eye; but when you perceive the Altitude to diminiſhed, which you'll eaſily diſcover by ſeeing at the repetition of the Obſervation, the Sea inſtead of the Horizon, forbear any farther Obſervation, and do not alter your Croſs; but as the Croſs ſtands, count the degrees and minutes on the ſide proper to the Croſs, which gives the Meridian Altitude required; and the Meridian Altitude ſubſtracted from 90, gives the Zenith Diſtance, if it be not graduated on the ſtaff.

If it be hazy, or ſomewhat thick weather, the Fore-ſtaff may thus be uſed; but if the Sun ſhine out, they either obſerve the upper Limb of the Sun, and afterwards ſubſtract the Sun's Semidiameter from the Altitude, or elſe uſe a coloured Glaſs on the top of the Croſs to defend the ſight from the ſplendor of the Sun.

To obſerve the Diſtance of two Stars, or the Moon's Diſtance from a Star.

Place the Staff's flat end to the Eye, as before directed, and looking to both ends of the Croſs, draw it nearer, or remove it farther from the Eye, as you ſhall find occaſion, till you can ſee the two Stars, the one on the one end, and the other on the other of the Croſs; then look what degrees and minutes are cut on the

ſide

ſide of the Staff belonging to that Vane in uſe, and that is the true diſtance required.

Some uſe this Croſs-ſtaff backward, in taking the Sun's Meridian Altitude, thus.

To make a backward Obſervation of the Sun's Altitude with the Croſs-ſtaff.

You muſt have an Horizon Vane to fix upon the Center, or eye-end of your ſtaff; alſo a ſhooe of Braſs to fit on to the end of any of the Croſſes, which is inſtead of a Sight-Vane. Then, when you would obſerve, having put on the Horizon-Vane, and fix'd the ſhooe on the end of a convenient Croſs, turn your back to the Sun, and looking through the ſight in the Braſs ſhooe, lift up or down the end of the ſtaff, till the ſhadow made by the upper end of the Croſs, fall upon the ſlit in the Horizon-Vane; and at the ſame time you can ſee the Horizon through the Horizon-Vane, then the Degrees and Minutes cut by the Croſs on the proper ſide is the Altitude: but if there be fixed a Lens, or a ſmall double Convex-Glaſs to the upperend of the Vane, to contract the ſun-beams and caſt a ſmall bright ſpot on the Horizon-Vane, poſſibly it may be found more convenient than the ſhadow, for as much as that is commonly imperfect and double.

But if the Declination be the same w
that the Meridian Altitude is, and also gre
er than the Meridian Altitude, then the Su
or Star may have two Meridian Altitudes i
twenty four hours, *viz.* the one above th
Pole, and the other below. And then th
sum of the Codeclination and Altitude is th
heighth of that Pole towards which the De
nation is.

The

The Figure of the Quadrant.



The

The Description and Use of the Quadrant.

This Instrument is said to have been the Contrivance of Captain *Davis*, that wrote the *Seaman's Secrets*, and therefore is sometimes called *Davis*'s Quadrant. It's a very convenient Instrument for to take the Sun's Altitude at Sea; it consists of three Vanes, A, B, C, and two Arches: that at A is called the Horizon-Vane; that at B the Shade-Vane, because of it's giving the shadow upon the Horizon-Vane, in time of Observation; and that at C the Sight-Vane, because in time of Observation it's placed at the Eye.

The lesser Arch d e is the Sixty Arch; and that marked f g the Thirty Arch. The Sixty Arch is divided into sixty degrees, commonly by every five, but sometimes by single degrees; in time of Observation the Shade Vane is placed upon this Arch always to an even degree. And the Thirty Arch into 30 degrees, and each of those degrees into minutes, by Diagonal Lines: in time of Observation the Sight Vane slides upon this Arch. Both Arches together (tho of differing Circles) contain ninety degrees, whence it's properly called a Quadrant.

To

To observe with the Quadrant.

Having put the Horizon-Vane upon the end of the Quadrant at A, the Shade-Vane upon the sixty Arch d e, to a number of degrees less than the Co-altitude by 15 or 20 degrees, and the Sight-Vane upon the thirty Arch F G, turning your back towards the Sun, lift up the Quadrant, and look through the small hole in the Sight-Vane, and so raise or lower the Quadrant, till the shadow of the upper edge of the Shade-Vane fall upon the upper edge of the slit in the Horizon-Vane; then if at the same time the Horizon appear through the said slit in the Horizon-Vane the Observation is finished: but if the Sea appear instead of the Horizon, then remove the Sight-Vane lower towards F; but if the Sky appear instead of the Horizon, then slide the Sight-Vane a little higher, and so continue removing your Sight-Vane, till the Horizon appear through the slit of the Horizon-Vane, and the shadow of the Shade-Vane fall at the same time on the said slit of the Horizon-Vane; then look how many degrees and minutes are cut by the edge of the Sight-Vane that answers to the sight-hole, and to them add the degrees that are cut by the upper edge of the Shade-Vane, the sum is the Zenith Distance, or Complement of the Altitude: but to find the Sun's Meridian, or greatest

Altitude,

Altitude, you must continue your Observation as long as you see the Altitude increase, which you'll perceive by having the Sea appear at the repearing the Observation, instead of the Horizon, by removing the Sight-Vane lower; but when you see the Sky appear instead of the Horizon, the Altitude is diminished; therefore desist from farther Observation at that time, and add the degrees upon the sixty Arch to the deg and min. upon the thirty Arch, the sum is the Zenith-Distance or Co altitude of the Sun's upper Limb or Edge.

2. Of late there has been used a Lens or double Convex-Glass fix'd in the Shade-Vane, which contracts the Rays, and casts them in a small bright spot on the slit of the Horizon-Vane, instead of the Shade, which has much improved the Instrument, if the Glass be well and truly fix'd; for now it may be used in hazy weather, and that so thick an haze that an Observation can hardly be made with the Fore-staff; also in clear weather the spot is more defined and conspicuous than the shadow which at best is not terminated: this was the contrivance of ingenious Mr. *Flamsted*.

1. Seeing it's the Zenith-Distance, or Co-altitude of the upper Limb of the Sun that is given by the Quadrant, when observing by the upper edge of the shade, and not the Center, you ought to add 16 min. the Sun's semidiameter, to that which is produced by your Observation,

ſervation, and the ſum is the true Zenith-Diſtance of the Sun's Center, but if you obſerve by the lower part of the ſhade of the ſhade-Vane, then it's the lower Limb of the Sun that gives the ſhade, and therefore you muſt ſubſtract 16 minutes from what your Inſtrument gives: but again conſidering the height of the Obſerver above the water, which is commonly between 16 and 20 Feet, we may take five or ſix from the ſixteen minutes, and make the allowance but ten or twelve minutes, to be added inſtead of the ſixteen minutes.

Note alſo that the Refraction of the Sun or Stars, cauſeth them to appear higher than they are, therefore when you have made your Obſervation, look page the Refraction anſwering thereto, and ſubſtract it from your Altitude, or add it to the Zenith-Diſtance, ſo ſhall you have your Altitude exact and correct.

Rules for finding the Latitude, or Height of the Pole, by the Zenith Diſtance, Meridian or Altitude of the Sun, or Stars, and their Declinations.

Note that ſo much as the Zenith is diſtant from the Equinoctial towards the North or South, which is called Latitude, ſo much is the

the respective Pole elevated above the Horizon.

If the Sun or Star have no Declination, the Zenith-Distance is the Latitude, and then if the Sun or Star come to the Meridian due North, the Latitude is Southerly; if it come to the Meridian South, the Latitude is Northerly.

If the Sun or Star be in the Zenith, then the Declination is the Latitude; and if the Declination be Southerly, the Latitude is Southerly; but if the Declination be Northerly, the Latitude is Northerly.

In all other cases consider the position of your Zenith, the Equinoctial and Star, whether the Zenith be between the Equinoctial and Star; or the Star between the Equinoctial and Zenith; or the Equinoctial between the other two; for according thereto is the Rule of Working varied; but the position of the Zenith is known by the Meridian, Altitude and Declination, and therefore shall form my directions according.

1. If the Declination be North or South, either of the Sun, or Star, and the Meridian Altitude be the same way that the Declination is, the Difference between the Declination and Zenith-Distance is the Height of that Pole towards which the Declination is.

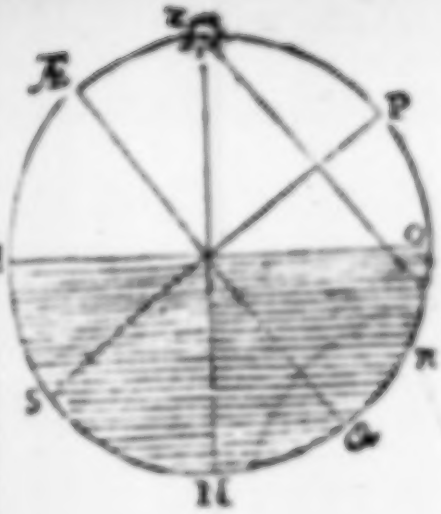

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Fig: A
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Fig: B
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Fig: C
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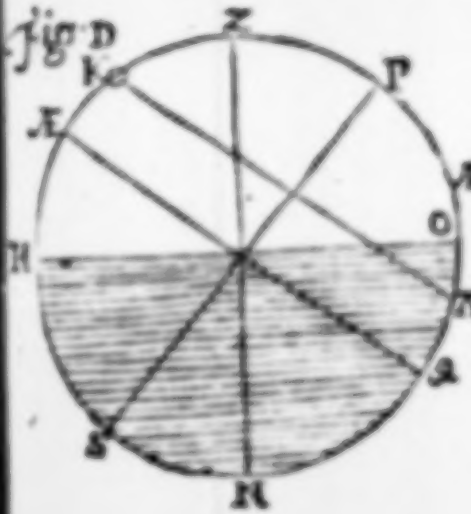
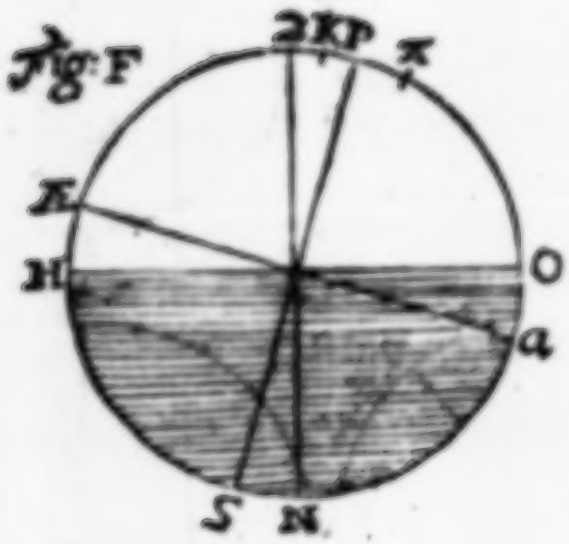

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Fig: E
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HÆZPON Represents the Meridian.
ÆE The Equinoctial.
EA The Parallel of Declinations.
HO The Horizon.
SP The Axis of the Equinox.
ZN The Axis of the Horizon, and Prime Vertical.
P The North Pole.
S The South Pole.
Z The Zenith.
N The Nadir.

H The South Point of the Horizon.
O The North Point.
H K or O K The Meridian Altitude.
Z K The Co-altitude, or Zenith-Distance.
Æ K The Declination.
Z Æ The Latitude.
O P The Poles Observation.

Fig: G



EXAMPLE.

EXAMPLE.

Fig. A.

The Zenith between the Equinoctial, and the Sun, or Star.

	Deg. Min.
The Declination North	23 30 Æ K
The Zenith Distance North	8 30 Z K
The Latitude North	15 90 Æ Z

Except the Declination be less than the Zenith Distance, then the contrary Pole to the Declination is elevated.

EXAMPLE.

Fig. B.

The Equator between the Zenith and the Sun, or Star.

	D. M.
The correct Zenith Dist. South.	71 30 Z K
The Declination South.	20 00 Æ K
Latitude North.	51 30 Æ Z

EXAMPLE.

EXAMPLE.

Fig. C.

	D. M.
The Zenith Distance North.	30 00 Z K
The Declination North	20 00 Æ K
Latitude South	10 00 Z Æ

If the Declination of the Sun or Stars be North or South, and the Zenith Distance be contrary to the Declination, the sum of the Co-altitude and Declination is the height of that Pole that the Declination is towards.

EXAMPLE.

Fig. D.

The Sun or Star between the Zenith and the Equinoctial.

	D. M.
The Zenith Dist. South.	31 30 Z K
The Declination North.	20 00 Æ K
Latitude North.	51 30 Z Æ

EXAMPLE.

EXAMPLE.

Fig. E.

The Sun or Star between the Zenith and Equinoctial.

	D. M.	
Declination North 23 deg. 30 min. Compl.	66 30	P K
Meridian Altitude North.	8 30	K O
The Elevation of the North Pole.	75 00	P O

Except the Meridian Altitude be more than the Declination, then ſubſtract the Zenith Diſtance from the Codeclination, and the Remainder is the height of the Pole, towards which the Declination is.

EXAMPLE.

Fig. F.

The Zenith between the Equinoctial and Star.

	D. M.	
The Declination North	80 00	Æ K
The Zenith Diſtance North	5 00	Z K
Latitude North	75 00	Z Æ

Note

Note that which way ſoever the Meridian Altitude be, if the Meridian Altitude and twice the Codeclination be leſs than 180, the Sun or Star hath two Meridian Altitudes, and by the ſecond Rule you may have the Latitude.

EXAMPLE.

Fig. G.

The Sun or Star between the Equinctial & Zenith.

	D. M.	
The Meridian Altitude South	77 00	H K
The Declination North 62 deg. 00 min. the Compl. ———	28 00	K P
	28 00	P A
	133 00	H A

Leſs than 180 deg. therefore by the ſecond Rule,

	D. M.	
The Zenith Diſt. South	13 00	K Z
The Declinat. North	62 00	Æ K
The Latitude North	75 00	Z Æ

That the attendance on a Star's coming to the Meridian, might not be tedious, I ſhall ſhew.

To find the time of a Stars coming to the Meridian any day.

Having looked the Right Aſcenſion of both the *Star* and *Sun* in their proper Tables, ſubſtract the Right Aſcenſion of the *Sun* from the Right Aſcenſion of the *Star*: but if the *Stars* Right Aſcenſion be leſs than the *Sun's*, ſo that you cannot ſubſtract, add thereto twenty four hours, and then ſubſtract, and the Remainder, if under twelve hours, is the time of the *Stars* coming to the Meridian after noon; but if the Remainder be more than twelve hours, ſubſtract 12 therefrom, and the Remainder is the time after Midnight.

EXAMPLE 1.

September 15. it's required to know when *Fomahant* comes to the Meridian, I find in the Table the *Star's* Right Aſcenſion to be 22 hours, 44 m. and the *Sun's* Right Aſcenſion 12 h. 1 m. which ſubſtracted from the *Star's* Right Aſcenſion, leaves 10 h. 31 m. the time of the *Star's* coming to the Meridian after noon.

EXAMPLE

EXAMPLE II.

Suppoſe the time that the Bull's South Eye comes upon the Meridian, *Feb.* 28, 1688, be required,

	H.	M.
The Right Aſcenſion of the Star	22	40
Twenty four hours added	24	00
	46	40
The Sun's Right Aſcenſion ſubſtract	23	25
Remains	23	15

The true time that the Bulls Eye will come to the Meridian that night.

To find at any time what Star is then upon the Meridian.

To the Sun's Right Aſcenſion add the time from Noon given, and the ſum is the Right Aſcenſion of the point of Heaven, that will come to the Meridian at the propoſed time, with which enter the Table of the Stars Right Aſcenſion, and ſee what Star hath ſuch right Aſcenſion, or neareſt thereto, and that is the Star ſought for.

EXAMPLE.

September 21, let it be required to know w
Star will be upon the Meridian at eleven o
Clock at night.

	H.	M.
The Sun's Right Aſcenſion is	12	4
The time from Noon	11	0
Their ſum is	23	4

The Star that is neareſt in Right Aſcenſion
Markab, whoſe Right Aſcenſion is 23 hou
50 minutes, and comes to the Meridian wi
4 minutes of 11 a Clock, the time propo

*To find the time of the Sun-Riſing, or Sett
with the length of the day and night in any
of the world.*

In Table, page find the day of
Month in the two outward Columns of Mar
and the Latitude you are in at the Head of
Table, and in the ſquare meeting of theſe
you ſhall find the time of the Sun's Riſing
Setting.

If you double the time of the Sun's Riſi
you have the length of the night: but if
dou

...ble the time of the Sun-setting, you have ...e length of the Day.

EXAMPLE.

... Admit the time of the Sun's Rising, Setting, ...gth of the Day and Night be required on ...*ember* 18, in the Latitude 28 deg. North.

Here is neither the day of the Month, nor ...e Latitude to be found exactly; but I can ...d *November* 17 in the Table, and Latitude ... deg. which are the neareſt to thoſe given, ...d following theſe in the ſquare of meeting, I ...d the Sun to ſet at 5 hours, 8 min. and ... rife 49 min. after ſix of the Clock. 5 h. ...min. doubled gives 10 h. 16 min. the length ... the day, and 6 h. 49 m. doubled: gives the ...gth of the night, 13 h. 38 m.

...ſt the time of any Star that is between the Tro-...icks, Riſing and Setting with the time of its ...ing above the Horizon in any place of the world.

... Firſt, Look in the Table of the Sun's De-...nation, what day in the year the Sun will ...ve as much Declination as the Star, then ...h that day, and the given Latitude enter the ...ble of the Sun's Riſing and Setting, and in ...e common Angle you will have the Stars ſemi-...rnal Arch, or half time of it's being above

the Horizon, if in the entring you look
Month and Day in the Left Hand Column,
the Latitude North, or in the Right Hand
lumn, and the Latitude South. Now if
ſubſtract theſe hours and minutes from the
of the Stars coming to the Meridian, the
mainder will be the true time of the Star's
ſing; but if you add, the ſum will be the
of the Stars ſetting, and that before Midnig
if the ſum be leſs than twelve hours; but if
exceed twelve, caſt away twelve, and the
is the time after Midnight.

EXAMPLE I.

Let it be required to find the time of
Riſing and Setting of the Bull's South Eye,
eighteenth of *November*, Latitude 42 deg.
min. North.

The Declination of this Star is 15 deg.
min. North, and by the Directions before g
ven, it will come to the Meridian that day
twelve of the Clock at night.

By looking in the Tables of the Sun's Dec
nation, I find the Sun to have ſuch Declinat
as this Star, *viz.* 15 deg. *ſouth* on the twen
third day of *April*, which twenty third d
looked in the Table of the Sun Riſing und
42 deg. Latitude (or that being not to
found) under 40 deg. gives 6 h. 54 m
which, ſeeing the Declination and Latitude
bo

ch North is the ſemidiurnal Arch, or time
e the ſtar is paſſing from the Horizon to the
ridian; or from the Meridian to the
rizon.

	H.	M.
hen the time of the Stars South	12	01
e Stars ſemidiurnal Arch	6	54
e time of the Star's Riſing, P. M.	7	07
e time of the Stars Riſ. in M.	6	54

EXAMPLE II.

Let it be required to find the time of the
ſing and ſetting of *Aldebaran*, the eighteenth
November in Latitude 42 degrees, 00 minutes
orth.

The time of it's coming to the Meridian
at day, is twelve of the Clock at night, and
e Sun comes to have equal Declination with
on the twenty third of *April*.

Looking *April* 23. on the Right Hand of the
Table under 40 degrees Latitude, I find the
Stars ſemidiurnal Arch to be

	H.	M.
	5	6
Which ſubſtracted from the time of the Star's coming to the Meridian, or Northing ———	12	1
The time of the Star's Riſing in the Evening ———	6	11
The time of the Star's ſetting in the Morning ———	5	7

EXAMPLE III.

Let it be required to find the time of the Riſing and Setting of *Syrius*, the fifteenth of *November* in Latitude 50 *deg.* 00 min. North. The Declination of this ſtar is 16 *deg.* 15 minutes ſouth, and the ſun comes to have ſo much ſouth Declinat. *October* 27, with which entring the Table of ſun's Riſing, I find the ſemidiurnal Arch to be

	H.	M.
	4	40
The time of coming to the Meridian, I find	2	26
To which I add	12	00
	19	26
The semidiurnal Arch subſtracted	4	40
The time of the ſtar's Riſing in the Evening	9	45
The time of its ſetting in the Morning	7	06

To nearly eſtimate the time of the Moon's Riſing, or Setting.

At the New ſhe riſeth and ſetteth with the Sun.

At the Full ſhe riſeth when the Sun ſets, and ſets when the Sun riſeth.

At the beginning of her Increaſe, ſhe riſeth after Sun-Riſing, and ſets after Sun-ſetting.

At the beginning of her Decreaſe, ſhe riſeth a little after the Sun ſets, and ſets a little before the Sun riſeth.

At her firſt Quarter ſhe riſeth about Noon, and ſets about Midnight.

Laſtly obſerve, that ſhe riſeth every day later than the other by about 48 minutes.

To find the Diſtance of the Sun or a Star's Riſing from the Eaſt, or ſetting from the Weſt, and conſequently what point of the Compaſs it ſhould riſe, or ſet on in any place of the World.

Look for your Latitude in the Head of the Table, and the Declination in the firſt Column on the Left Hand, and in the common Angle of meeting you'll find the Amplitude deſired, which if divided by eleven degrees and a quarter, will give the Points of the Compaſs.

EXAMPLE I.

In the Latitude 42 deg. 00 min. North, the Sun's Declination being 11 deg. 00 min. North I demand the Amplitude.

The Table being entred, as directed, the Amplitude, is found 14 deg. 53 min. which is one Point and a quarter.

If the Declination be North, the Amplitude is North, and if the Declination be ſouth: ſo that here the the Declination being North, the Amplitude is 14 deg. 53 min. North, and the ſun or ſtar ſhould riſe Eaſt by North, one quarter Northerly, and ſet Weſt by North one quarter Weſterly.

The

The Description and use of the Nocturnal.

There are two kinds of Nocturnals, the one made for the Great Bear, and the other for the little Bear; yet both consisting of like parts, one Description will serve both. This instrument is composed of three pieces, or parts, the first and biggest on which is the handle by which to hold it in time of Observation, hath on the fore-side two Circles, in the outermost of which are the Days of the Months, and upon the innermost the twenty four hours: upon the back-side are the thirty two points of the Compass, and sometimes, especially if it be for the Little Bear, the Dist. of the Pole-star, above or beneath the Pole.

If the Nocturnal be for the Great Bear, then you'll see in the Circle of Month *February* 17, at the top: but if it be for the Little Bear, *April* 25.

The second, or middle piece, or part contains two Circles and a small Tooth, or Index: the outermost Circle is divided into twenty nine days and a half, for the Moon's Age, the innermost into twenty four hours: the Index is a little short peg standing out from the edge, and is to be set to the day of the Month, as occasion requires.

The third and upper, or innermost part, or piece is a long Index, the edge of which that

comes from the Center must be brought ov
the Guards in observing. Sometimes on
Nocturnal is made for both Bears.

*To find the hour of the Night, and upon what pa
of the Compass the Guards are.*

First, set the Tooth of the middle part w
the day of the Month, then lift up the Instru-
ment, and hold it as upright as you can, wit
the fore-side towards you, and afterwards bo
the upper end or tip on the top of the Noctur-
nal, so much towards you, that looking throug
the Center-hole in the middle of the Noctur-
nal you may see the Pole-star. Now when yo
see the Pole-star through the hole, turn th
long Index or Rular about, till by the edg
coming from the Center, you can see the firs
of the Guards of the Little Bear; if th
Nocturnal be made for the Little Bear, or dir
to the Pointers of the great Bear, then shall th
edge of that Index or Rular shew upon the in-
nermost Circle of the middle part or piece
the hour of the night; and at the same tim
on the back-side of the Nocturnal, the Poin
of the Compass on which the Guards are.

If you desire to be more exact in the time o
the night, take the Altitude of some know
star, and proceed according to following

To find the time of the Moon's coming to the Meridian by the Nocturnal.

Look for the Moon's Age in the outermost Circle of the middle piece of the Nocturnal, and right against it on the innermost Circle of the same piece is the time of her coming on the Meridian.

The use of the following Table of North Stars distance above or beneath the Pole.

Having taken the Altitude of the Pole Star, observe with the Nocturnal, as above directed, upon what Point the Guards or Pointers are: then looking in this Table for the Distance or Declination, and if the star below the Pole, add it to the Altitude; but if the Star be above the Pole, substract, and the Sum or Remainder is the Latitude of the place.

A Table

A Table of the Diſtance of the Pole Star above or beneath the Pole upon every Point of the Compaſs the Guards and Pointers are upon.

Points on the Noſtur.	For 1st. G. lit B.		The Pole Star is
	D	M	
North	2	09	above the Pole.
N. by E.	1	32	
N. N. E.	1	29	
N. E. by N.	1	02	
N. E.	0	35	
N. E. by E.	0	06	
E. N. E.	0	22	The Pole Star is under the Pole.
E. by N.	0	52	
East.	1	18	
E. by S.	1	41	
E. S. E.	2	01	
S. E. by E.	2	16	
S. E.	2	25	
S. E. by S.	2	30	
S. S. E.	2	29	
S. by E.	2	23	
South.	2	11	
S. by W.	1	55	
S. S. W.	1	34	
S. W. by S.	1	10	
S. W.	0	43	
S. W. by W.	0	14	
W. S. W.	0	15	
W. by S.	0	44	
West.	1	11	The Pole Star is above the Pole.
W. by N.	1	31	
W. N. W.	1	58	
N. W. by W.	2	14	
N. W.	2	25	
N. W. by N.	2	30	
N. N. W.	2	21	
N. by W.	2	12	

If the foremoſt of the Guards be aſcend. from the South, or upper part of the Meridian.

If the foremoſt part of the Guards be deſcend. from the S. or up. par. Mer. the North, or lower part of the Meridian.

For the Points of great Bear.			
	D	M	
Pole Star above the Pole.	2	20	
	2	32	
	2	35	
	2	31	
	2	20	
	2	13	
	1	55	
	1	33	
	1	07	
	0	31	
The Pole Star under the Pole.	0	08	
	0	22	
	0	51	
	1	20	
	1	44	
	2	04	
	2	20	
	2	30	
	2	33	
	2	28	
	2	16	
	2	01	
	1	41	
	1	15	
	0	47	
	0	18	
	0	08	
The Pole Star above the Pole.	0	22	
	0	52	
	1	20	
	1	44	
	2	04	

If the Pointers be deſcending from the South, or upper part of the Meridian.

If the Pointers, otherwiſe called the Aſſer. Wheels of the Wain be aſcended from the North, or lower part of the Meridian.

This Table is added merely upon the Account of the World's being used to have it inserted in Books of this kind, and will censure any Book imperfect, that shall be without it, tho of vere little Use.

Of Spherical Triangles.

1. A Spherical Triangle is a Triangle made on the surface of the Globe, by three Arches of great Circles, mutually intersecting each other.

2. Every Spherical Triangle consists of six parts, *viz.* three sides, and three Angles.

3. The sides are Arches each less than a Semicircle.

As the sides of Plain Triangles are measured by a scale of equal parts, so these are to be measured by an Arch of equal parts, or Degrees.

4. The measures of the Angles are Arches of Great Circles described from the Angular Points, and subtending the Angles.

5. A great Circle of the Sphere is that which bisects, or divides the Sphere into two Hemispheres, or Halves; as the Equinoctial, Ecliptick, Horizon, Meridian, &c.

6. The Poles of a Circle is a point in the surface of the Globe, distant always 90 degrees from

from the Circumference of its Circle.

7. The Distance of the Poles of two great Circles is equal to the Angle made by them at the point of Intersection. Therefore

8. Those Circles which cut each other at Right Angles, the one of them shall pass by the Poles of the other, and Cont.

7. If two sides of a Spherical Triangle be continued, they shall intersect again at a semicircle, and shall make an Angle equal to the former opposite Angle; as in the Figure.



Hence if a Spherical Triangle hath two sides, each of them severally greater than a Quadrant, you shall in the resolving thereof keep the least side, with it's opposite Angle, and for the other two both sides and Angles, take their Complements to 180 deg.

10. If

If three great Circles make by their Interſections a ſpherical Triangle, and if the Poles of thoſe Circles be the Angular Points of another Triangle, the Angles of the firſt Triangle ſhall be equal to the ſides of the ſecond; and the ſides of the firſt to the Angles of the ſecond.

Hence it is evident how the Angles of a Triangle may be changed into ſides, and conr.

11. The ſum of the three Angles of a ſpherical Triangle is greater than two right Angles, but leſs than ſix.

12. Two Angles of any ſpherical Triangle are greater than the difference between the ſum of the three Angles, and a ſemicircle.

13. Any ſide being continued, the exterior Angle is leſs than the two oppoſite inward ones.

14. In any ſpherical Triangle, the difference of the ſum of two Angles, and a whole Circle is greater than the difference of the third Angle and a ſemicircle.

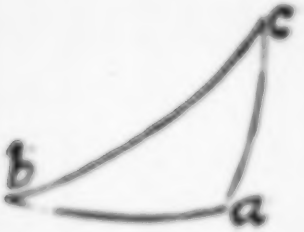
15. A ſpherical Triangle is either Right-Angled, or Oblique-Angled.

16. A Right-angled ſpherical Triangle is that which hath one Right Angle at the leaſt.

17. In a Right-Angled ſpherical Triangle, either of the Oblique Angles is greater than the Complement of the other; but leſs than the Difference of the ſame Complement to a ſemicircle.

Of

Of Right-Angled Spherical Triangles.



In these there are five parts besides the Right Angle (which is esteemed as none) the Angles b c, and sides a b, b c, and c d any two whereof being given, a third may be found, by the two following Axioms.



Prop. Let B A C represent a Right-Angled Spherical Triangle, right-angled at A; so that A B be the sine of the Base, B C the sine of the Hypoth. C F the Sine, and A K the Tangent of the other Leg. I H the sine, and M L the Tangent of one of the Angles, viz. that at E.

AXIOM I.

As E A the sine of one Leg,
Is to E M the Radius:
So is A K the Tangent of the other Leg,
To M L the Tangent of the Angle B.

AXIOM II.

As B C the sine of the Hypoth,
Is to E H the Radius:
So is C F the sine of the Leg C A.
To H I the sine of the Angle B, and the contrary.

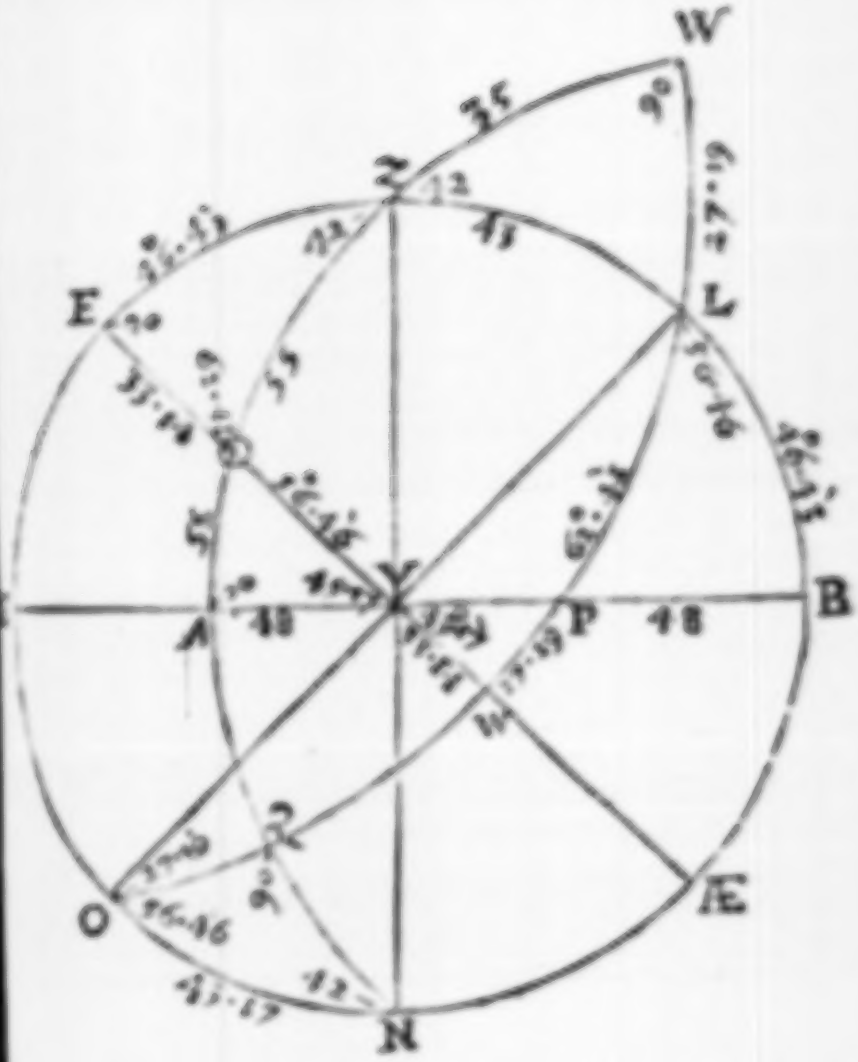
By these two, I say, may be solved all right-angled spherical Triangles; but then the sides of the Triangle for the most part must be produced, that there may be divers Triangles made by their intersections (as in the next Scheam) consisting of parts of the first Triangle, or their Complements, and afterwards it must be considered to which of all those Triangles one of the said Axioms may aptly and

and immediately be applyed for finding the thing required, or it's Complement.

That any right-angled ſpherical Triangle having the ſides thereof continued to Quadrants, will produce five other right-angled Triangles, all made of the ſame parts, or the Complements of thoſe of the firſt Triangles.

See the Scheam.

White



Where let E Z O be a right-angled Triangle projected, right-angled at E, let P be the Pole of the Circle Z O N, L the Pole of E V.

Through

Through the points O P L describe the Arch O P L and continue it beyond the Limb, viz. to W, where it shall concur with N O Z produced.

Here is

1. The Triangle Z W L, right-angled at W.

2. Whereto is equal the Oppofite Triangle N Q O.

3. The Triangle O A V right-angled at A.

4. The oppofite Triangle thereto V W P, right-angled at W.

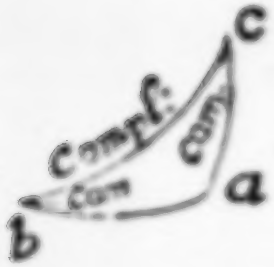
5. The Triangle P p L right-angled at E.

Whence it's evident how any Caſe may be varied both in Calculation and projection.

From the fore-mentioned two Axioms, and conſiderations of the laſt Scheam, was deduced the following noble Axiom, ſerving for the ſolutions of all right-angled Triangle, without producing any ſide.

Firſt, Note that of the five parts of a right-angled ſpherical Triangle, thoſe three fartheſt from the right Angle, as the two Angles b and c, and the Hypoth b c are called Complemental Parts.

There



There always comes three of the five parts into a queſtion, two given, and one required, and theſe three lie either all together, as b a, a c and c, or a c, c, b c or b c b, b a, or c, b c and b, b, b a, a c (for the Right Angle parts nothing) in all which five Caſes, a c, c, b, b c and b a are the means or middle parts, and the other are called Extreams adjacent or adjoyning, or elſe one part lyeth by it ſelf disjoyned from the other two, as b a, b c and c, or b c, b a, c a, or c b, b a, wherein b a, b c and c, are ſeparate from the reſt, and then that part which is alone and disjoyned is called the Mean, and the other two are called Extreams oppoſite, or disjoyned.

The

The General, or Fundamental Axiom.

The Sum of the Logarithm, Sines of the middle part and Radius, is equal to the sum of the Tangents of the Extreams adjacent, or of the Cosines of the opposite Extreams.

If the middle part be required, put the Radius first, that is, in the first place of a proportion; but if one of the Extreams be required, put the other Extream first.

This solves all the sixteen Cases of right-angled spherical Triangles.

Of Oblique Spherical Triangles.

In Oblique spherical Triangles there always comes four parts into the question; three given to find a fourth. There are twelve Cases, two whereof, *viz.* these, where the parts coming into the question are opposite, are solved by the next following Axiom alone.

AXIOM I.

In all Spherical Triangles the Sines of the Angles are directly proportional to the Sines of their opposite sides, and the contrary.

Eight more may be solved by letting fall a Perpendicular

Perpendicular from one of the Angles down upon the Base, whereby the Triangle is divided into two right-angled Triangles, and the solution requires two Operations.

Note, that if the Angles at the Base be both of one kind (that is both obtuse, or both acute) the Perpendicular falls within the Triangle; if of divers kinds, without.

In letting fall the Perpendicular, note that for as much as in every of these 8 Cases there is given a side, with an Angle adjoyning.

1. Let fall the Perpendicular from the end of that given side which is adjoyning to an Angle given, so that it may be also opposite to the said Angle.

2. And when that is not sufficient, let it be also in it's falling, opposite to the Angle required, or to the side required.

The first of these Conditions is necessary to be observed in all the eight Cases mentioned.

But this being somewhat intricate, I shall lay down Mr. *Oughtred's* Proportions, by which those eight Cases may readily be solved without any Perpendicular.

1. As the Sine of the Difference of two sides,

Is to the Sine of half their sum.

So is the Tangent of half the Difference of two Angles,

To the Cotangent of half the contained Angle.

2. As

2. As the Cosine of half the Difference of two sides,

Is to the Cosine of half their sum:

So is the Tangent of half the sum of two Angles,

To the Contang. of half their contained Angle.

3. As the Sine of half the Difference of two Angles,

Is to the Sine of half their sum:

So is the Tangent of half the Difference of two sides.

To the Tangent of half the interjacent sides.

4. As the Cosine of half the Difference of two Angles,

Is to the Cosine of half their sum:

So is the Tangent of half the sum of two sides,

To the Tangent of half the interjacent sides.

If the half Difference of two Angles be added to their half sum, the aggregate will be the greater Angle; but substracted from it, the Remainder will be the lesser. The same holds of the half sum, and half difference of two sides.

If you have two sides and an Angle opposite to one of them given, to find the third side, or two Angles with a side opposite to one of them, to find the third Angle, you must first by opposite sides and Angles, find another

Angle

ngle, or ſide, and then by inverting theſe ropoſitions, proceed.

Three Sides being given to find an Angle.

Note, that the ſide oppoſite to the Angle quired, is here called the Baſe, and the o- er two the containing ſides.

Firſt, ſay, as the Radius is to the ſine of one the containing ſides, ſo is the ſine of the her to a fourth ſine.

Then as that fourth ſine is to the ſine of half e ſum of the three ſides, ſo is the ſine of the ference between that half ſum of the three es, and the Baſe, to a ſeventh ſine, to which d the Radius, and half that ſum will be the ſine of half the Angle required.

If three Angles be given to find a Side:

Take the Complement of the greateſt An- e to one hundred and eighty degrees, and en the Angles are changed into ſides, and e operation will be the ſame with the laſt.

Of the COMPASS

THis Instrument called a Compass, is on such a Compass-Card as is describe page made by the passing a steel Wi well touched with the Load-Stone, under th Meridian, or North, and South-Line there to shew in all places the Azimuths, especially th thirty two, called the Points of the Compa which it doth not with the same exactness i all places alike; but has in most places a De clination or Variation: the North Point, whi is chiefly regarded in this matter, standing Point, two, nay, sometimes three, and mo from the true intersection of the Horizo and North part of the Meridian, which is th true North Point of the Horizon.

Which Variation, tho by some counted a imperfection in the Compass, I rather take t be it's greater perfection. Providence there pointing at something more excellent than w apprehended. How to observe the Magneti Amplitude or Azimuth, by the Azimuth Com pass, I shall not need to shew: almost eve one that maketh and selleth them, being rea to instruct you in that, grate, if you buy on

To find the Variation of the Compass, which way it is, and how much.

Having observed the Magnetical Amplitude, ake the true Amplitude out of the Table of mplitudes, page thus, look the Lati-ude on the head thereof, and the Declination own along the Left Hand Column, and under e Latitude, and right against the Declination, u'll have the true Amplitude. Now by these find the Variation, and which way it is, e following Rules will direct.

With the Chord of sixty degrees describe a rcle, and quarter it with two Diameters at ght Angles the one to the other, writing a-ainst the Extreams of the Diameters, North, uth, East, West, as you see in the Figure. hen take the true Amplitude, or Azimuth, nd prick it from the proper point the right y, and so also prick off the Magnetical Am-itude, or Azimuth. Lastly, take the di-ance between the Magnetical Amplitude, or zimuth, and the North, and set it from the int of true Amplitude, or Azimuth, North-ard, or towards the North, and the foot of e Compasses will fall in a certain point, from ich, if you draw a Line through the Center, at Line will represent the Magnetical North, nd South Line, or Magnetical Meridian, and at way that this Point lieth from the North,

that way is the Variation, and juſt ſo mu
as is the Arch between the ſaid point and t
North, which may be meaſured by the Chor

EXAMPLE I.

July 22, in 48 deg. 00 min. North Latitud
the Magnetical Amplitude at Sun-Riſing w
obſerved to be 36 deg. 00 min. from the Ea
Northward, what was the Variation, an
which way?

The Declination then was 18 deg. 00 mi
North.

Firſt, With this eighteen degrees, Declin
tion and forty eight degrees Latitude, entr
the Table of Amplitudes, page you
find the true Amplitude to be twenty ſev
degrees, thirty minutes. Then having d
ſcribed the Circle, and quartered it, prick t
true Amplitude from E, or the Eaſt-Point t
wards the North to B, and taking the Magn
tical Amplitude thirty ſix degrees, prick th
alſo from E. Northward to C, and taking
the Compaſſes the diſtance between C and
the North; ſet one foot in E, the Point of tr
Amplitude, and the other being turned t
wards the North, reaches to M, the Point
which the North Point of the Compaſs is d
rected, ſo that N N eight degrees, thirty m
nutes is the quantity of Variation, and becau

falls towards E., that is between N and E, ...Eastward.

	D.	M.
M. Ampl.	36	00
True Ampl.	27	30
Variat.	8	30



Now if you take an old Compass-Card, ... within this Circle, so that it's North ... South Line may lie on the Line M P, then ...

will this Compass-Card represent the vari
Compass, and the Circle N E S W, the Hori
zon, or Compass without Variation, so that
you take with a pair of Compasses the d
stance between the North, or Point N of th
outward Circle, and the Point of your Cour
on the varied Compass or Card, representing
and afterwards set one foot on M, the oth
will shew on the Compass-Card, amongst th
Points the true Course.

Or thus, you may have two Compass-Card
to move one upon the other, as you see in th
next page.


ESE
SE

And taking the true Amplitude from the graduated Limb, set it from the East Point (if the Observation be at Rising) either West Point of the under or fix'd Compass, either towards the North or South, according as the Amplitude is; prick also the Magnetical Amplitude thereon, after the same manner to C; then take the Distance between the Point of Magnetical Amplitude C, and the North Point of the lower, or fix'd Compass, prick it from E, the Point of true Amplitude to M, and bring the North Point of the Movable, or upper Compass to M; then if you look any Course on the upper Compass, the Point against it on the neather Compass is the True Course, or the contrary.

EXAMPLE II.

In the Latitude 41 deg. 00 min. North, the Sun having seventeen degrees, no minutes, Declination South, the Magnetical Amplitude at Sun-set is observed to be thirty six degrees, no minutes from the West Southward, What is the Variation, and which way is it?

By entring the Table of Amplitudes with the Latitude and Declination, as before directed, the true Amplitudes will be found to be 21 deg. 47 min. which being pricked on the Circle from W (as before directed) to b, and also the Magnetical Amplitude to C.

M.

	D.	M.
M. Am.	35	00
T. Am.	22	47
Var.	13	13

The distance between m N shews the Variation to be 13 degrees, thirteen minutes, and that Eastward from the North.

EXAMPLE III.

	D.	M.	
Let the Declination be	15	00	N.
The Latitude	50	00	N.
The Magnetick Amplitude at Sun-Rising.	29	00	S.

And it be required to find the Variation of the Compass.

Having described a Circle, and quartered it, prick the True Amplitude (which by the Table of Amplitude is found to be) twenty three degrees, forty four minutes, from the East Northward from E. the East Point towards the North to b, and the Magnetical Amplitude twenty nine degrees, no minutes from E. Southward (according to the Observation) to c; then taking the distance between c the Magnetick Amplitude, and N the true North;

set it from b Northward, and it finds the Point M, the distance between M and N is five two degrees, forty four minutes, the Variation which is Westward, because it falls between N and W.

	D.	M.
M. Amplitude.	29	00
T. Amplitude.	23	44
Variation from the N. W.	52	44

Of this I shall shew more Examples afterwards.

How to find where Currents are, and which way they set, and their drift in rate of driving.

A good way to discover the great and most notable Currents, is by keeping an exact account of your way both outward and homeward according to your dead Reckoning, being very curious in observing the way your ship makes, by the Log-Line; for it is not your correct account, but your dead Reckoning, that is here to assist you, therefore you must be careful to try how the ship goes by it when you sail near the Meridian, how she's drawn from her course; as again, when she's steered directly East or West, take good notice if she alter her Latitude. As for those guessings by

ripplings of the water, and drawing of froth, &c. along the ſhoar, when in ſight of it, they can ſtand a man but in little ſtead. But the moſt uſual and uſeful way of obſerving a Current is thus; when there's a ſmooth Sea, and not much wind, have out the Boat, taking in her three or four hands, a Compaſs, a Log-Line, and half minute Glaſs, with a Line, or Coil Warp of above an hundred Fathoms long; to the end of which Line faſten a triangular piece of Board, as the Board A B C:



faſt to one of the Angles faſten a good weight of Lead to ſink it: ſome uſe inſtead of this Board a Kettle eyed by the Eail.

When you are off from the ſhip, caſt over your Board or Kettle, letting it ſink, at leaſt fifty Fathoms; but if you have Line enough let it go one hundred, or one hundred and 20 Fathoms; then belaying the Line faſt about her ſtem, it will bring her up, and make her ride as if at an Anchor. Then caſt over your Log,

Log, turn up the Glass, and as you veer ou
the Log-Line, set the drift of the Log u
your Compass, so shall you know whet
there be any Current or not, and if any, h
it's set and rate of driving, remembring to a
always to the drift, if the Line she ride by
60 Fathoms one third part, if the line be 80
one fourth part, but if one hundred Fathom
the one fifth part, &c. of the drift more
the drift of the Boat; for tho the Boat ten
to ride, or lie still, yet she's found by exper
ence to drive the mean time: but whether th
Allowances be the very truth, I shall not muc
contend, yet are delivered as agreeing w
experience, and therefore may be used till e
very ones experience better informs him; w
not that the bigger the Weight and Load
that the Boat is to be rid by, the less will
her drift.

Of Lee-way.

That you may be the better able to judge
a Ships Lee-way, always when you are by
Wind, and have Land in sight just on Head,
take notice as you keep the ship steered on th
Point the Land bore on, how she glides away
to Leeward, and the Land appears still more
and more to Windward; for by such kind of
Observations, taking notice of the sail about,
steers of Wind, ships trim, and growth of the

Sea,

Sea, the Judgment may be so strengthened, that a man shall rarely fail in giving a pretty true allowance.

If the Land in sight be not right on Head, yet by taking notice of the point it was on at first and how it weathers in keeping the same course, you have the same advantage to edifie your Judgment.

Of the Nature of the Line described, or the Ship's motion, when steered by a Rightfied Compass on any oblique Point thereof, or Rumb.

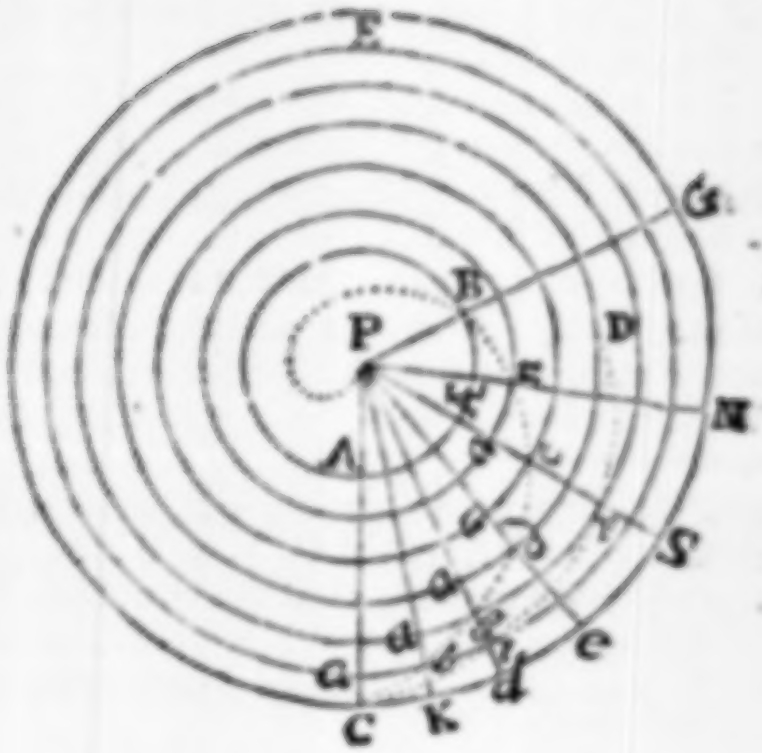
The Rumb-Line is from the very nature of the Compass, by which it's traced, a Line that makes equal Angles with every Meridian through which it passes, and seeing the Meridians tend one to another till they meet in the Poles, must needs be a curving or bending Line; and for as much as no Circles but the Equinoctial and it's Parallels make, or can make equal Angles with all Meridians, it cannot be a Circle, but such a Curve which some call an *Helix*, or because on the surface of the Globe an Helliptical Line. It always tends nearer and nearer the Poles, and very near the Poles it turneth round the same often, in many twirls, Gyrations, or turnings. So that how small a part soever thereof be taken, it will still differ both

both from a right Line, and Arch of a Circle, yet the ſmaller the ſegment thereof is, the nearer it's to a Right Line.

Of the Nature of the Triangles made upon the Globe by the Rumb-Line, Meridians and Parallels of Latitude.

Let P repreſent the Pole of the Globe, all the ſtraight Lines drawn there-from, as P C, P K, P D, P E, P S, P N, P G Meridians; all the Concentrick Circles parallels to the Equinoctial, and they ſo many as there are minutes in the Meridian.

Let



Let a ſhip be ſuppoſed to have kept a juſt North East Courſe from the Point C in the Equinoctial, and thereby to have drawn the Curve, or North East Rumb-Line, c, b, g, d, e, n, B, P approaching nearer and nearer the Pole as continued, and the foreſaid Meridians to be ſuch as paſs through the Points where this Rumb-Line croſſes the former Parallels. Then ſhall there be made by this Rumb-Line, the Meridians and Parallels certain ſmall Triangles, which

which we ſhall take to be right-angled, and ſtraight-lined, tho indeed they are neither; yet in a ſmall diſtance they are inſenſibly differing there-from.

In the Triangle c a b right-angled at a; c b is the diſtance run on the Rumb-Line, a b the departure from the Meridian, and a C is the Difference of Latitude, which is equal to the Difference of Latitude, made in any other part of the World by ſuch a diſtance run on the ſame Rumb, as is alſo the Departure from the Meridian: for the ſides b a, a g, a d are equal one to the other, as are alſo the ſides c a, b a, g a, d a, ſeeing the ſides c b, b g g d the diſtances with the Angles at C, b, g, d are equal. But equal Separations, or Departures from the Meridians on different Parallels of Latitude make various Differences of Longitude; for thirty Leagues Departure on the Parallel of ſixty degrees, no minutes of Latitude, makes three degrees, no minutes difference of Longitude, when thirty Leagues Departure on the Equator makes but one degree and a half; ſo that the ſide E, K, tho but equal to C K, makes twice as many degrees of Longitude; hence ariſeth one great error on the Plain Chart, by ſuppoſing, as it doth, that equal Departures on all Parallels make equal Differences of Longitude.

Note, that tho the ſides a b, a g, a d, a e be equal; yet a b is leſs than C K, and a g than

than b i, &c. so that in a critical sence, if a ship should return by the opposite Rumb she went, as from b to C, seeing the side C K, the Departure, returning, is greater than the side a b her Departure in going the Angle C B K, shall be greater than the Angle a C b, and consequently the ship should fall wide of C, nearer K, and not arrive at C, as may be experienced by resolving the two Triangles C a b, and b K C, yet this difference is so very little, that tho by numbers it may be discovered to be somewhat; in practice at Sea it can make no error, and a ship may return by the opposite Rumb, that error being only a speculative nicety.

In any of these Triangles having any two parts, the other may be found, as having C A the difference of Latitude with the Angle a c b the Course, the sides C b, the Distance, and a b the Departure, and consequently the Angle C P b the Difference, or Longitude may be found, or having the sides C b, a b, we may find the side C a, and the Angle a C b, &c. for it's other parts. In the whole Rumb, Triangle C a B C B is the whole distance, and C A the whole difference of Latitude, and the whole Departure from the Meridian is not given in any one Triangle, but in divers Triangles (being as much in one as in another) so that the whole Departure is the sum of a b, a g, a d, a c, a n, A B, and the whole

difference

difference of Longitude is the Arch C G, whose parts C K, K d, d e, e s are unequal.

Note also in all the Rumbs between the same Parallels, there's the same *ratio* of the Easting or Westing to the Degrees of Longitude, that is, letting the two Rumb Lines C B, C D run till they cut the Parallel a, b, 1, E, I say that such proportion as a b, the Miles Easting or Westing made by the Rumb C, b, g, d, has to a 1, the Easting or Westing made by the second at the same Parallel of Latitude, such proportion has C K the Difference of Longitude made by the first Course to C d the difference of Longitude made by the second. And producing these Rumbs farther, till they cut the Parallel a, g, F, in g and F, then such proportion as a g has to a F, such has the Difference of Longitude K x, to the difference of Longitude K s, or such as is the *ratio* of a g to g F, such is that of K d to d s. Hence I make any one Rumb supply all the rest in this business of Easting and Westing, as you may see in the last Examples of the Use of the Table.

Of the Quantity of a Degree of a Great Circle on the Earth, and how it's found.

THere are many ways of discovering the quantity of a Degree on Earth; but none so natural and certain as that used by Mr. *Norwood*, which was to measure with all exactness possible, the distance between some two places, lying directly under the same Meridian, or North and South one of the other (the farther distant the better) and to compare that with the Degrees and Minutes in the Difference of the Latitudes of those two places; the Latitudes of both places being observed with all the niceness and curiosity imaginable.

By this means he found no less than three hundred sixty seven thousand two hundred of our English Feet to answer to a Degree of Latitude, which hath been farther since confirmed by many other experiments in our own Country, but the greatest confirmation is, that by the very same manner of experiment, *viz.* by measuring between two places under a Meridian in *France* hath been found three hundred sixty five thousand one hundred eighty four English

Feet

Feet in a Degree. But Mr. *Norwood* conſidering that the ſhips way is more than is really given by the Log, and that it's more ſafe to have the Reckoning ſomewhat before the ſhip ſtand away the ſeven thouſand two hundred, retaining only threee hundred ſixty thouſand Feet to one degree, and conſequently ſix thouſand Feet to a minute, or one ſixtieth part of a Degree, according to which account there's of our Statute-Meaſure of five thouſand two hundred and eighty Feet to the mile, ſixty eight miles and two parts of eleven to a Degree, and of Engliſh Sea-miles, or Italian miles, of five thouſand Feet to the mile, ſeventy two miles, or twenty four Leagues in a Degree, and the whole Circumference of the Earth is eight thouſand ſix hundred and forty Leagues, which is one hundred and twenty Leagues leſs than the French Experiment makes it: and than really are.

Of the Eſtimation of a Ships way at Sea.

IN the now practice of Navigation there's hardly any thing more neceſſary than to be able to make a good Eſtimate of the ſhips way with

with any wind, according to all Circumstances.

For which many ways have been thought of by Wheel-works, &c. but to little purpose; the Nations now of Fame and Experience at Sea making better work with less craft. Some only guessing by the sail born, and running of the Froth or Water by the ship's side, as the Spaniards and Portuguese; others by flinging into the water a Chip, or the like; and counting how many equal timed paces they can make on the Deck, while the said Chip drives between any two Bolt-Heads or Mar'ks on the side, which is usual amongst the Dutch; (instead of paces you may number the Pulies while the Chip drives:) but the most approved way, and now most followed is by our English Log, and Log-Line.

Of the Log and Log-Line.

The Log is only a piece of Wood, which being tied to a Line, and cast over-board, and the Line veered out as fast as the Log will carry it away, or as the ship sails, so that it may have leave to pull away as much Line as it can without being dragged by the ship any more than what the very weight of the Line will do, doth shew according to the time it's veering how much

much she has sailed, and consequently her rate of Sailing.

This Line at about ten fathoms from the Log, which is allowed, that the Log may be out of the Eddy of the ships wake before the half minute, which is the time most commonly allowed for the veering the Line, begins to run, has a mark or knot for the beginning, and from thence is marked into spaces called Knots.

The space of Line between Knot and Knot ought to be such a part of a minute of a degree, as the half minute time is of an hour; so that the half minute being the one hundred and twentieth part of an hour, the length of Line between Knot and Knot should be the one hundred and twentieth part of a minute of a deg. of a great Circle of this Globe of Earth and Water; and a minute being, as before proved, six thousand English Feet: the length of Line between the Knots ought to be fifty Feet: but they are commonly knit at but seven fathoms, or forty two feet distance, grounding upon this error, that there's only three hundred thousand Feet in a degree, and but five thousand in a minute; yet it being still found by the ships run, that this did not answer, they have lessened their half minute by about five seconds, which brings it to the same thing in effect. Nevertheless, it were to be wished, that the later, tho it serve a turn, might be omitted, and the true half minute brought in use, with the

Log-

Log-Line knit at it's true Lengths.

So many Knots as are veered in half a minute, so many miles the ship sails in an hour, or so many Leagues, and so many miles in a Watch, or four hours.

So seven Knots in half a minute, is seven miles in the hour; eight Knots in half a minute is eight miles in an hour.

The Log is commonly thrown every two hours, but some throw it every hour.

Every noon, if possible, the Latitude ought to be observed; but whether Observation or none, the Master and his Mates then call for the Log-board, and add up the Knots and Fathoms run since the last Noon, the sum shews the miles sailed that twenty four hours, if the Log were cast every hour; but if it were cast but once in two hours, they double the sum of the Knots run, and that shews the miles sailed: if you would have the Leagues sailed, divide by three: but the keeping the Reckoning in miles is to be preferred before that in Leagues. By a League here understand not three Italian or English miles, but three such miles as sixty of them will make a Degree, that is there such miles, sixty whereof are equal to seventy two Italian Miles.

This Account rust taken off the Board, ought to be entred in a Book called the Traverse-Book, or Log-Book; and afterwards the Traverse from the last day noon being worked,

and

and the difference of Latitude and Departure found, and corrected by Observation, if any made, must be entred fairly in another Book, called the Journal.

Of the Log-Book and Journal.

THe Log-Book is to represent the Waste-Book in Accounts, and ought to contain all requisite Occurrences, as the Wind and Point of the Compass your ship lyeth upon, and what allowance you make for Lee-way, all bearing up, lyings by, sight and bearings of Land, soundings, the knots and fathoms run each hour, the Latitude and Variation of the Compass, &c.

The Journal is to represent the Ledger or Fair-Book, and ought to contain the correct Accounts, which may be contained in nine Columns; in the first is the Month and Day, in the second, the observed Latitude; in the third, the correct Course; in the fourth, the correct distance; in the fifth, the Northings; in the sixth, the Southings; in the seventh, the Eastings; in the eighth, the Westings; in the ninth, the Departure, if kept according to the Plain Chart, or else the difference of Longitude.

At

At any time, when you'll know the ships
er, put the Northings and Eastings as Cre-
ers, and the Southings and Westings as
rors, and you'll find instead of the ballance,
e which will shew the ships place.

ailing by the Arch of a Great Circle.

his, tho it shew the neareſt way and di-
stance between two places, yet cannot
e so much in use as the two former kinds of
ing; men being drawn from it by conveni-
n of Winds and Currents; or else forced
n it by cross Winds, or interposition of
e Head-Lands, Shouls, or Islands, &c.
therefore I shall not spend much time on
but advise all to the Mercator. Only note,
t by having skill herein, you may see that
many times the nearer way to leave the
th, and to sail into a greater Latitude.
As in sailing from the Lands end of *England*
New Found-Land, there's great advantage in
distance to raise and depress the Pole ten or
ve degrees, besides a benefit it yields in
tifying the Account. And that many times
en the account is kept by the Plain Chart,
d the ship sails not home as she went out, that

 circle

either the going, or returning being the c
nearer to a great Circle than the other, cau
a great difference, and the distance one w
greater than the other; so that returning fr
the West *Indies*, the ships fall with the Lan
End, or many Leagues before they come,
their great hazard.

If the two places over which the great Cir
is to pass, be both under the Equinoctial, t
Equinoctial is the great Circle, and the diff
ence of Longitude between the two places
the distance, and the Course between is dire
ly East or West.

If the two places lie both under one Me
dian, that is directly North and South, and t
one of them situate under the Equinocti
then are the degrees of Latitude of the oth
the distance.

If both places be under the same Meridi
and both have Latitude of the same Denom
nation, that is both North, or both Sou
then the difference of Latitude turned in
miles is their distance.

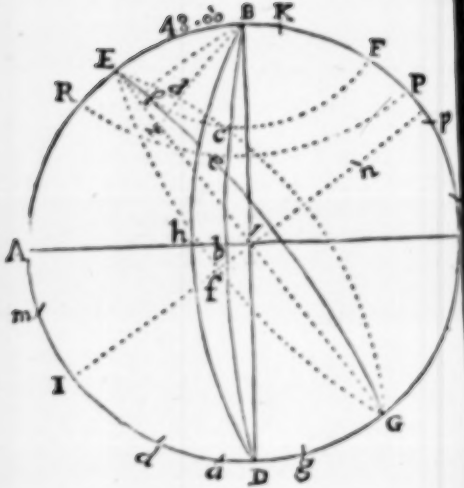
If both places lie under the same Meridi
but have Latitude, the one North, and the
ther South, then the sum of the Latitudes
both places is the distance, unless the distan
be above one hundred and eighty degrees.

Propositio

positions of Great-Circle-Sailing.

e Difference of Longitude of two places under the same Parallel of Latitude being , to find the Great Circle Distance be- them, and the Angles of Position, or ng.

mit two places in the Latitude, fifty four , no min. differing in Longitude 79 , thirty minutes; and it be required to their Distance by the Arch of a Great .


43.00
B
K
E
F
R
P
p
c
e
n
A
h
b
f
m
I
G
d
a
D
b

Describe a Circle, as A B C D; as it is in the foregoing page, and quarter it with two Diameters A B, C D, at right Angles one to the other then prick the Difference of Longitude from A to a, and laying a Rular over a, find the Point b, and describe the Arch b D. Afterwards prick the Latitude from C to E, and from C to F, and by laying a Rular over E C, find the Point, and describe the Arch E C F.

Lastly, Draw the straight Line E V C, and describe the Arch E C G. A B C D represents the Meridian of one of the places; B b D the Meridian of the other, E c F the Parallel of Latitude; B D one Pole; D the other; B D the Axis; A V C the Equinoctial; E the one place; c the other; E c G the great Circle passing over both places.

Arithmetick.

In the Equicrural Spherical Triangle E B C, given the Angle E B C the difference of Longitude, and the two sides E B, and B C, each equal to the Colat. to find the Angles E and C, and the side E C.

From B imagine a Perpendicular to be let fall to the Arch.

From B imagine a Perpendicular, B d to fall on the Arch E C, which will divide the Triangle E B C into two right-angled Triangles E d B, C d B.

To find the side E C, the Great Circle Dist

In either of the right-angled Triangles E e d B are given the side E B, and Angle the half difference of Longitude to find the half Arch E C. Here E B is the m and E d, and Angle B adjacent extreams whereof is sought, therefore say

As the Radius 10.00000

Is to the sine of E B or B C 26 deg. 00 min. } 9,76921
So is the sine of 39 deg. 45 m. being the half Ang. E B c, the half difference of Long. to the sine of 22 deg. 5 min. } 9,80177 / 19,57501
The half of E C the Great Circle Dist. whence the great Circle Dist. is 44 deg. 10 min. } or 2650

But the distance according to the Rumb, on the Parallel is 2804 m.

For the Angles of Position, or Bearings.

In the right-angled Triangle E d B is gi the side E b the Colat. and Angle E B d half difference of Longitude, to find the A gle B E D. E B is the mean, and the t

An

ngles d E B, E B d are extreams adjacent, e of which is required: therefore say

the fine of 54 degrees the Latitude	9,907918
to the Cotang. 39 deg. 41 m. the half difference of Longitud.	10,080038
is the Radius	10,000000
To the Tang. of 56 deg. 03 min. the Angle of Potition.	20,080038 9,907918
	10,172080

Which gives North West by West.

To find the greatest Latitude the Arch shall pass through.

In the right angled Triangle EdB. are given the side EB, and Angle EBd, to find the side dB the Complement of the greatest Latitude The Angle E B d is the mean, and the two sides EB, B d are extreams adjunct, one whereof is sought, beginning with the other say,

As the Cotang. of E E 36 deg. 00 min.
Is to the Radius ——————
So is the Cofine of Angle EEd 39 deg. 45 m
To the Tang. of dE th
Complement of the greateſt Latitude.

The Latitudes of two places lying in th ſame Hemiſphere, their Diff.rence of Long tude being given to find the great Circle D ſtance between them and the Angles of Po ſition.

Admit the *Lizard* in Latitude 50 deg 00 m North, and Cape *Cod* in the Latitude 42 deg 20 min. North, and their difference of Lon gitude to be 66 deg. 00 min.

Having deſcribed a Circle, and quartered it, lay the Latitude of the *Lizard* from A t E. and draw E V, and the Latitude of Cape *Cod* from A to B, and from C to P, and de ſcribe the Arch B P, then prick the differ ence of Longitude ſixty ſix degrees from A t d, and laying a Rular over Ed find the Point h and deſcribe the Arch BkD. Laſtly, through E e G deſcribe an Arch which ſhall be the great Circle paſſing over both places, E repreſents the *Lizard*, e Cape *Cod*, E e the great Circle Diſtance between them.

Arithmetick

Arithmetick.

In the Obliqne Spherical Triangle E B e is given, the Angle B the difference of Longitude, the fide E B the Colat. of the *Lizard*, and the fide B e the Colat. of Cape *Cod*, to find the Angles E and e, and the fide E e.

	D.	M.
E B	40	00
e B	47	40
2)	87	40
	43	50 Half fum of fid. giv.
2)	7	00
	3	30 Half diff. of fid. giv.

As the fine of 43 deg. 50 min. the half fum ——— } 9,840459

Is to the fine of 3 deg. 30 min. the half diff. ——— } 8,785675

So is the Cotang. of 33 deg. 00 min. the half contained Ang. } 10,187423

18,973158

To the Tang. 7 deg. 44 m. the half diff. of 2 unknown Ang. } 9,132699

As the Cosine of 43 deg. 50 min. } 9,8181150

Is to the Cosine of 3 degrees, 30 min. } 9.999189
So is the Cotang. of 33 deg. no min. } 10,187483

To the Tangent of 64 deg. 51 min. the half sum of the unknown Angles. } 20,186672 / 10.328521

D.	M.
64	5
7	44

The greater Ang. 72 35 or Ang. of Cap. bear.

The Angle of 57 07 the *Lizard's* bearing.

Now say,
As the sine of the Angle E 72 deg. 35 min. } 9,979618

Is to the sine of 47 deg. 40 m. B C. } 9,868785
So is the sine of 66 deg. Ang. E. 9,960732

To the sine of E c 45 deg. 03 min. the great Circle Distance. } 19,829115 / 9,849897

Which

Which makes 2703 miles; but the diſtance according to the Mercator's Chart is 2778, and the bearing of Cape *Cod* from the *Lizard* is, Weſt by South neareſt.

To find the greateſt Latitude the Arch ſhall paſs through.

In the right-angled Triangle E Z B right-angled at Z is given the Angle Z E B, and the ſide EB to find the ſide ZB, which is the Complement of the greateſt Latitude, and the Angle E B Z. Afterwards if you would find the Latitudes, this Arch ſhall paſs through at every ſecond, third, or fifth degree from either E or e, by ſubſtracting the two, three, or five degrees, *&c.* continually from the Angle E B Z, you will have in the right-angled Triangles l B Z, the Angles l B Z, and ſide Z B, to find the ſides l B the Colat. and Angle l the bearing.

If you would find the difference of Longitude, and Angle of Poſition, or Courſe at every degree Alteration of Latitude, then in the right-angled Triangle l Z B, is given the ſides Z B and l B to find the Angle Z l B the courſe, of Angle l B Z the difference of Longitude from the Perpendicular, and you may find the ſide z l the diſtance to be ſailed in making that Alteration.

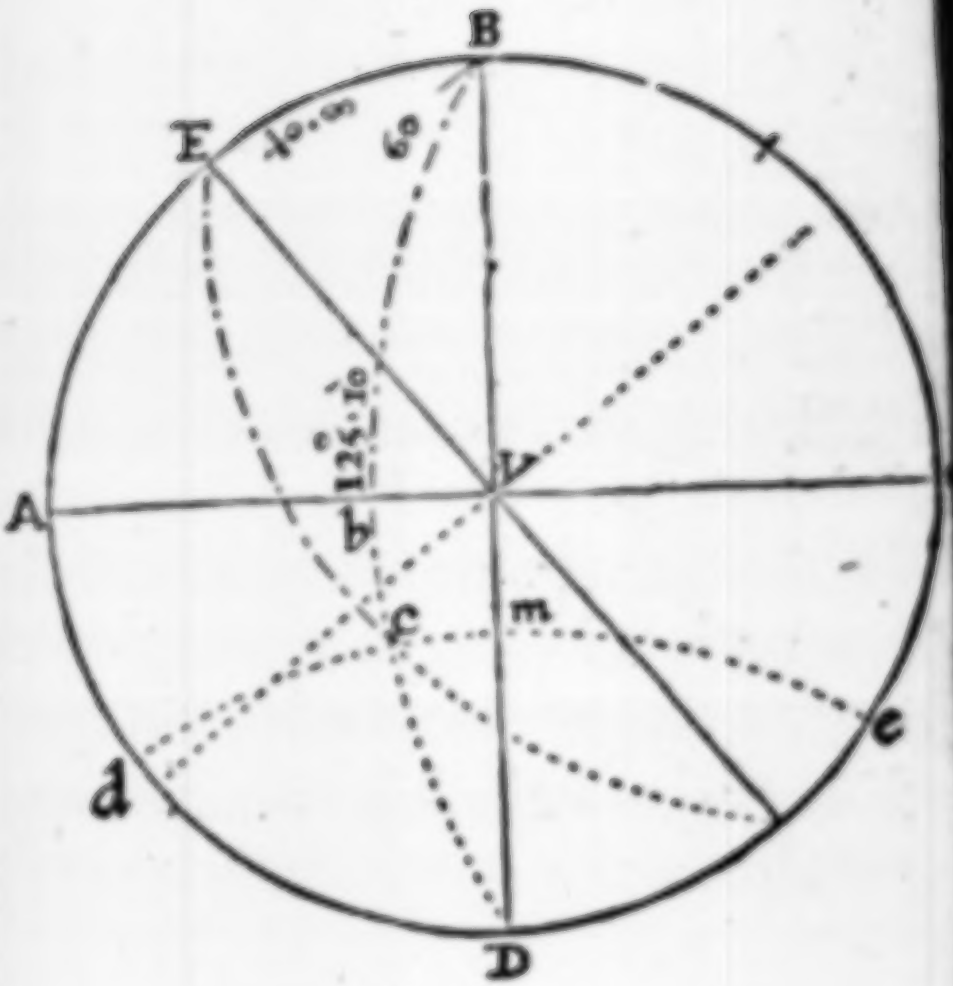
If

If you'll find the Latitude and Longitude she is in, which the Course shall be allowed one quarter, or half a Point, &c. In the right-angled Triangle l z B is given the side Z B, and Angle z l B, to find the Angle l B Z the diffence of Longitude, from the Perpendicular, the side lB the Colat. and the side l z the distance.

The Latitudes of two places the one on the one side, and the other on the other side of the Equinoctial, and their difference of Longitude being given to find the Great Circle distance between them.

Two places, the one in 50 deg. no min. Lat. North, the other in 35 deg. 10 min. South Latitude, differing in Longitude 60 degrees.

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DUBLIN.


B
E
40.0
60
125.10
A
V
A
c
m
e
d
D

Having described a Circle, and quartered it with two Diameters, at right Angles prick 50 degrees the one Latitude from A to E. Then prick 35 degrees 10 minutes from A to d, and from C to E. Lay a Rular over A e, and find the Point m. Then describe the Arch d m e, prick sixty degrees, the difference of Longitude from A to a, and laying a Rular over B a, find the point b. Then describe the Arch BbD. Lastly, draw the straight line EVG, and describe the E c G. Then is A C the Equinoctial B D it's Poles, E the place in North Latitude, e the place in South Latitude, B E A is the Meridian of the place E, B e b D the Meridian of the place C, E e G is the great Circle passing both places.

Arithmetick.

In the Oblique spherical Triangle E B e, are given the Angle B 60, and the two sides B E 40, B C 125 deg. 10 min. to find the Angles B E e, the Bearing of the place e, and the Angle B e E the Bearing of the place e, and the side E e the great Circle Distance.

FINIS.

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FINIS.

VVEIGHTS AND MEASURES, WITH The TALE of ſeveral GOODS.

COLLECTED

for the benefit of YOUTH IN ALL

SCHOOLS,

But eſpecially of

GUILDFORD in *SURREY.*

LONDON,
Printed by *William Godbid* for *Robert Harford,*
at the *Angel* in *Cornhil*, 1677.

lections of Measures, Weights, and Tale of Goods, for the Use of GUILDFORD-Schools.

ALL Quantity is divided into Measure, Weight, and Number. Measure is either Applicative or Receptive.

Applicative Measure.

Note, that 3 Barly-Corns (according the Statute) makes an Inch. 2 $\frac{1}{2}$ Inches kes a Nail. A Palm or Hand is 4 Inches Fingers breadth (and by this is meeted e size of Horses.) 3 Hands make a Span, d 4 Hands or 12 Inches a Foot. 2 Foot a Step or Simple Pace. 5 Foot makes a ometrical Pace. 3 Foot, or 16 Nails ke a Yard. 1 $\frac{1}{4}$ Yards, or 20 Nails make *English* Ell. $\frac{1}{4}$ Of a Yard makes a *Dutch* ll or Stick (by which Tapestry is measured.)

6 Foot makes a Fathom. 10 Foot makes a Gad, or Geometrical Perch; but in some places 9 Foot. 16½ Foot makes a Statute Pole or Perch. 18 Foot a Woodland Perch which is used also in Fenns and Moors. 20 Foot makes a Forrest Perch, which is used also in *Lancashire*, and in *Ireland*. 18 Foot makes a *Scotch* Pole or Perch. 4 Statute Perches or 100 Links make a Chain. 125 Geometrical Paces make a Stade. 8 Stades, or 1000 Geometrical Paces make an *Italian* Mile, which is also used by *English* Men at Sea.

An *English* Mile is 1760 Yards. 8 Furlongs make an *English* Mile, as 8 Stades make an *Italian* Mile.

3 *Italian* Miles make a League *English*. 4000 Geometrical Paces make a Mean *German* Mile. 5000 Geometrical Paces make a Great *German* Mile.

40 Square Perches make a Rood, and 4 Rood an Acre, that is, 160 Perches in length, and 1 in bredth, or 80 Perches in length, and 2 in bredth, or 4 in bredth and 40 in length make an Acre, or 10 Chains in length and 1 in bredth make an Acre. 5 Acres ordinarily make a Yard-Land; and 100 Acres an Hide of Land. 10 Foot every way or 100 Square Feet is called a Square.

A Table of Squares, or Superficial Measure.

Engl. Miles.	640	2560	102400	1115136	3097600	27878400	4014489600
Acres.	4	160	1743	4840	43560	6272640	
Roods.		40	435.6	1210	10890	1568160	
Poles.			10.89	30.25	272.25	39204	
Paces.				2.77	25	3600	
Yards.					9	1296	
Feet.						144	
Inches.							

A Cubick Foot contains 1728 Cubic Inches, and a Cubick Yard is 27 Cubic Feet, or 46656 Cubick Inches. A Statute Brick is 9 Inches long, 4½ broad, and 2½ thick.

A Coard of Wood is 4 Foot over, 4 Foot deep, and 8 Foot long, which make 128 Cubick Foot.

A Stack of Wood is 3 Foot over, 3 Foot deep, and 12 Foot long, which makes 108 Cubick Feet. Great Logs Wood ſhould not be ſold by the Stack but by the Coard; and ſmall Wood by the Stack.

50 Foot of Timber makes a Load, 40 Foot a Tun, 20 Foot a Butt or Pipe and 10 Foot an Hogſhead.

18 Foot Square, and 1 Foot deep, or 324 Cubick Feet is called a Floor.

300 Foot of 2 Inch Plank, 200 Foot of 3 Inch Plank, 150 Foot of 4 Inch Plank, 400 Foot of 1½ Inch Plank, and 600 Foot of Inch Plank make a Load.

of Concave, or Receptive Measure, and first of Liquids.

Names of the Vessels	Bus	Pun.	Hog.	Gal.	Pots	Pints.
A Tun of sweet Oyl	2	3	4	236	472	1888
A Tun of Train or Whale Oyl	2	3	4	252	504	2016
A Tun of Wine	2	3	4	252	504	2016
A Butt or Pipe	1	1½	2	126	252	1008
A Tertian or Punchion of Wine				84	168	672
An Hogshead				63	126	504
A Terce				42	84	336
A Barrel of Beer, or 2 Runlets of Wine				36	72	288
A Kilderkin of Beer				18	36	144
A Firkin of Beer				09	18	72
A Barrel of Ale				32	64	256
A Kilderkin of Ale				16	32	128
A Firkin of Ale				08	16	64
A Gallon				01	2	8
A Pottle					1	4
A Quart					½	2

Which Liquids are measured by differen Gallons, that is, by Gallons of differen sizes or bigness, whose true capacities an distinction is Taught in Gauging.

The Beer and Ale Gallon is bigger than the Wine or Corn Gallons, because of its fro thing. Butter, Sope, Fish, Herrings, are measured by the Ale Gallon, and 12 Bar rels (of either) make a Last.

Pounds in weight besides the Cask.				
	lb			
	224	112	56	Butter.
	240	120	60	Sope.
Firkin -----	4	2	1	
Half Barrel	2	1		
Barrel ——	1			

BIBLIOTHECA COLL:SS:TRIN: DUBLIN:

The

The Weight of the Empty Cask for Butter and Sope, or the Tare.

		lb
The	Firkin	6½
	Kilderkin	13
	Barrel	26

Dry MEASURE.

	Chal.	Rat.	Com.	Strik.	Bush.	Peck	Gall.	Pott.	Pint.	Qua.
A Last —	2½	10	20	40	80	320	640	1280	2560	5120
A Wey or Load —	1¼	5	10	20	40	160	320	640	1280	2560
A Quarter of Wheat or a Seam —		1	2	4	8	32	64	128	256	512
A Coomb			1	2	4	16	32	64	128	256
A Strike				1	2	8	16	32	64	128
A Bushel					1	4	8	16	32	64
A Peck						1	2	4	8	16
A Gallon							1	2	4	8
A Pottle								1	2	4
A Quart									1	2

* Some make 6 Quarters of Meal a Wey, and 1 Wey and 3 Quarters a Last.

A1

All kinds of Grain, likewiſe Salt, Lime, Coals, &c. are meeted by the Gallon for dry meaſure, which is called *Wincheſter* meaſure. But Note, That as Sea-Coals and Salt are meaſured with this Buſhel, then they are heaped, or elſe there's allowed 5 ſtriked Pecks to the Buſhel, which is called *Water*-meaſure. 3 Such Buſhels make a Sack, 4 ½ Such Buſhels a Fat, or Flat, 12 Sacks, 4 Flats, or 36 Buſhels make a Chaldron of Coals, and on Ship-board they allow 21 Chaldron to the Score. Of Salt, 40 Buſhels make a Wey, and 10 ½ Wey an Hundred.

Jewiſh *or* Hebrew *Meaſures, both Applicative and Receptive.*

A common Cubit is ½ a Yard.

An Holy Cubit, or Cubit of the Sanctuary is 1 Yard.

The Kings Cubit is 3 Fingers bredth longer than the Sanctuary Cubit.

Receptive Meaſure.

A Kab, 1 Quart.

An Omer, 3 ½ Pints.

An Ephath ½, a Buſhel and a Pottle.

An Homer, 10 Ephaths.

An Hin, 3 Quarts.

Of

Of WEIGHTS.

WEights are of 4 ſorts, *viz.* Troy, Haverdupoiſe, Subtle, and Foyle Weight; all which as they be different in Quantity, ſo they have various uſes. By Troy Weight Gold, Silver, Jewels, Amber, Electuaries, Bread-Corn, Liquors, are weighed, and from this Pound Troy, are taken all meaſures for wet and dry commodities, and is commonly divided thus: 24 Grains make 1 penny Weight, and 20 Drams makes 1 Ounce, and 12 Ounces make 1 Pound. Silkmen uſe a Weight called Venice Ounce, which is 13 Drams, and 12 Grains; ſo that 12 Ounces Venice is but 8 Ounces 4 Drams Troy, or 9 Ounces Haverdupois; but of this there's no ſtandard, nor doth the Magiſtrate allow of it.

The Pound Haverdupois, though it be greater than the Pound Troy, yet is the Ounce leſs, becauſe the Pound Troy hath but 12 Ounces, and the Pound Haverdupois 16: By this Weight is weighed all Phyſical Drugs and Grocery, all groſs Wares, as Roſin, Wax, Pitch, Tarr, Tallow, Sope, Hemp, Flax, &c. all baſe Metals and Minerals, as Iron, Steel, Lead, Tin, Copper, Alome, Coppe-

Copperas, &c. and all things that have waſte.

The Pound Subtle is any ſmall quantity, made to repreſent any other great Weight whatſoever; as a Penny Weight Troy or leſs, to anſwer in due proportion to the whole Pound Troy, or to a Tun with all its parts. This Weight is private to aſſay Maſters, and ſuch as make Tryal of Metals, and to thoſe verſed in Statick: For as in Geometry we uſe a Subtle Meaſure of the Hundredth part of an Inch to repreſent a Yard, Rod, or Furlong, &c. ſo in Statick is uſed any ſmall Weight to repreſent a greater.

The Pound Foyle is leſs than the Pound Troy by $\frac{1}{12}$ of the Pound Troy, and is only of uſe amongſt thoſe that make Gold Foyle, Wire, and Pearls.

The Pound Haverdupoiſe is thus divided: 16 Ounces make 1 Pound, 8 Dragmas make 1 Ounce, 3 Scruples make 1 Dram, and 20 Grains make 1 Scruple, and 112 ſuch Pounds make a Hundred (which is called the great Hundred) and 20 Hundred make a Tun.

Apothecaries uſe in making up their Medicines the Troy Weight thus divided: Ounces, Dragmas, Scruples, Grains, as above. But in buying and ſelling Drugs, they uſe the Haverdupoiſe.

The

The Troy Pound to the Haverdupois is as 17 . 14.

The Troy Ounce to the Haverdupois is as 31 . 56.

A Tun Weight Haverdupois is always 20 Hundred of all things but Lead, which is 19 Hundred and a half to the Tun or Fodder. Mace, Cinamon, Nutmegs, Pepper, and Sugar, have 13 Pound and a half to the Stone, and 108 Pound to the Hundred; *Essex* Cheese and Butter the Clove is 8 Pound, the Wey 32 Cloves, or 256 Pound. In *Suffolk* the Clove is 8 Pound, the Wey 42 Cloves, or 360 Pound.

Hay should have 20 Hundred, but it is sold for 18 Hundred, 36 Trusses, or 2016 Pound. Wool is sold by the Clove, or Half Stone of 7 Pound, the Stone 14 Pound, Tod 28 Pound, Wey 182 Pound, a Sack 364 Pound, Last 4168 Pound. Iron and Shot are weighed 14 Pound to the Stone, 28 Pound to the Quarter, 112 Pound to the Hundred, and 20 Hundred to the Tun. A Fagot of Steel is 120 Pound, a burthen of Gad Steel is 9 Score, or 180 Pound. Among *Butchers* 8 Pound goeth to the Stone. A Gallon of Wheaten Meal weighs according to the common repute 7 Pound Haverdupois, and 8 Pound, 6 Ounces, 4 Drams Troy, and so a Bushel

Bushel 56 Pound Haverdupois, and 68 Pound, 1 Ounce, 12 Drams Troy.

A Tun of Wine weighs 17 Hundred Haverdupois, 2 Pint 1 Pound, and half an Ounce Troy.

Fineness of Gold is estimated by the Karract, which is no certain Weight, but the $\frac{1}{24}$ of any quantity: This Karract is divided into Grains and Parts.

The Karract that weighs Jewels is divided into 4 Grains, of which Grains 20 makes 24 Grains Troy, or 1 Penny Weight.

Gold to Silver are in value neer as 12 to 1: Therefore if an *Hebrew* Talent of Silver be valued at 375 Pound, that of Gold will be 4500 Pound.

The value of Gold here in *England* is as followeth. One Penny Weight of Angel Gold is worth 4 Shillings 2 Pence halfpenny; of Crown Gold 3 Shillings 10 Pence halfpenny; of Sovereign 3 Shillings 6 Pence halfpenny.

The Standard for Sterling Silver Money in *England* now is 11 Ounces, 2 Drams of fine Silver, and 18 Drams of Allay of Copper: So that 12 Ounces of pure Silver without any Allay is worth 3 Pound, 4 Shilling, 6 Pence, and an Ounce is worth 5 Shilling, 4 Pence halfpenny; but with Allay is worth 3 Pound the 12 Ounces, and but 5 Shilling the Ounce.

The

The Standard for Gold is in the Pound Troy 22 Karracts of fine Gold, and 2 Karracts of Allay, Silver or Copper, that is, 11 Ounces fine Gold, and 1 Ounce of Allay.

The *Spaniſh*, *French*, and *Flemiſh* Gold, is of equal fineneſs with the *Engliſh*.

The *Engliſh* Silver Money, hath leſs Allay than the *French* or *Dutch*.

		l.	*s.*	*d.*
Pound Troy of Gold	is worth	40	18	$4\frac{1}{4}$
Pound Hav. of Gold		49	13	$8\frac{1}{4}$
Pound Troy of Silv.	is worth	03	02	00
Pound Hav. of Silv.		03	15	$3\frac{1}{2}$

So that 100 Pound in Gold weighs only Pound, 11 Ounces, 3 Quarters.

And 100 Pound in Silver Money weighs 26 Pound, 9 Ounces Haverdupois.

When Wheat is at 5 Shillings the Buſhel, the Penny Wheaten Loaf muſt weigh 11 Ounces Troy, and 3 Halfpenny white Loaves to weigh as much, and the Houſhold Penny Loaf to weigh 14 $\frac{1}{2}$ Ounces Troy; and ſo proportionably more or leſs.

If a Baker want 1 Ounce in 36, he ought to ſuffer the Pillory.

A Miller, if he carry and recarry his Grist, is allowed 4 Pound or Pints in the Bushel for both Tole and waste, but if it be brought to him and carried back by the Owner, he ought to take but 2 Pound *per* Bushel. The waste in grinding is about 3 Pecks in a Load, or 1 Pound in the Bushel.

Hebrew *Weights.*

A Common Sheckle is 1 Shilling, 3 Pence.

A Sheckle of the Sanctuary is half an Ounce Troy, which of Silver is 2 Shilling 6 Pence.

A Talent of Silver weighs 3000 Sheckles, and is in value 375 Pound.

To weigh much with few Weights.

The Weights, 1 Pound, 3 Pound, 9 Pound, will weigh all from 1 Pound to 13 Pound. And 1 Pound, 3 Pound, 9 Pound, 27 Pound, will weigh all from 1 Pound to 40 Pound. And 1 Pound, 3 Pound, 9 Pound, 27 Pound, 81 Pound, will weigh all from 1 Pound to 121 Pound, *&c.*

The Tale of several Goods.

120 Ells of Canvas Cloth make a Hundred, 4 Ells of Fustian make 1 Chief, and 10 Ells of fine Linnen, Silk, and Syndon.

Codfish, Haberdine, Ling, &c. hath 24 to the Hundred, and 1240 to the Thousand. Eels 25 to the Strike, and 10 Strike to the Bind. Of Herrings and Stock-fish 120 to the Hundred, 12 Hundred to the Thousand, laid in a Barrel, and 12 Barrels to a Last. Deals and Nails are (for the most part) sold 120 to the Hundred.

Of Furrs, Filches, Grayes, Jennets, Martines, Mincks, Sables, 40 Skins make a Timber. Other Skins go 5 Score to the Hundred.

A Seame of Glass is 24 Stone, or 120 Pound.

A Bale of Paper is 10 Ream; a Ream 20 Quire, a Quire is 25 Sheets of some Paper, and but 24 of others.

A Roll of Parchment is 5 Dozen, a Dozen 12 Skins.

10 Hides are a Dicker, 20 Dickers make a Last.

10 Pair of Gloves make a Dicker, and so with 10 Horse-shooes.

Goats-Skins are numbred by the Kipp, 50 Skins to the Kipp.

Laths 5 Foot long muſt have 5 Score to the Hundred. Laths 4 Foot long go 6 Score, 120 to the Hundred or bundle. All Laths ought to be 1 Inch and a half broad, and ½ thick.

5 Hundred Bricks make a Load, and Thouſand plain Tiles make a Load.

21 Glaſs Bottles go to the Dozen among the Work-men in the Glaſs-houſe, and 12 ſuch Dozen, or 252 Bottles make a Groſs, and as many they can make in a day.

Of Bread 13 goeth to the Dozen, and 2 Dozen to the Score.

4000 Six Inch Tree-Nails, 3000 Nine Inch Tree-Nails, 2000 Foot, 1500 Eighteen Inch, or 1000 Two Foot Tree-Nails or Ship-pins go to the Thouſand, which will require a Load of Timber to make them.

5 Foot of *Newcaſtle* Glaſs make a Table, and 45 Tables make a Caſe. But of *Normandy* Glaſs 25 Tables make a Caſe: This latter ſort is commonly uſed in long Squares, Panes or Quarrels, but the former in Diamond like Quarrels.

In the City, Lime is ſold by the Bag, each Bag a Buſhel, and 25 ſuch Bags make a Hundred. In the Country in *Surrey* eſpecially it is ſold by the Load of 40 Buſhels.

70 Pipe Hoops, 90 Hogſhead Hoops, 120 Barrel or Kilderkin Hoops, or 180 Pink or Firkin Hoops make a Hundred or Bundle.

Of FUEL.

ALL Fuel ſized by the Statute is Shids, Billets, Fagots, and Coals.

All Shids muſt be 4 Foot long beſides the Carf, and upon them is 1, 2, 3, 4, or 5 marks or notches; and then they muſt be in compaſs about the midſt 16, 23, 28, 33, or 38 Inches, according as it hath number of notches.

All Billets ſhould be 3 Foot long, and there be 3 kinds thereof, as the Single, a Caſt, and a Caſt of two: The firſt being 7 Inches and a half about, the next 10, and the laſt 14 Inches compaſs.

Fagots ſhould be 3 Foot long, and the Band beſides the Knot 24 Inches made round: For flat Fagots be much leſs, though they be all one compaſs about: Spreas or Briſh hold the ſame ſize, but there goeth only 100 of them to the Hundred or Load, but Fagots are 120 to the Hundred or Load.

Coals have been before mentioned.

A Last of Powder is 24 Barrels or Firkins which must hold 100 Pound neat.

Of TIME.

IN a common year are 365 days 6 Hours, but in a Leap-year 366. In a Day Natural are 24 Hours; in an Hour 60 Minutes; in a Minute 60 Seconds, *&c.*

Also in a common Year are 52 Weeks, or 13 equal Months and 1 Day, or 12 unequal. An equal Month is 28 Days.

Of Motion and Time in Astronomy, *and of the Aspects of the Planets.*

NOte that 60 Seconds is one Minute, 60 Minutes one Degree, and 30 Degrees in the Zodiack or Ecliptick make a Sign; 2 Signs, or 60 Degrees is a Sextile ✶; 3 Signs, or 90 Degrees is a Quadrant or Quartile □; 4 Signs, or 120 Degrees a Trine △; 6 Signs, or 180 Degrees is an Opposition, or Semi-Circle ☍; 12 Signs, or 360

60 Degrees is a Conjunction ☌; and the Earths Annual, or Moons Monthly Motion. Note also, every Hour of Time, hath in Motion 15 Degrees of the Equinoctial; and one Minute of Time, hath 15 Minutes of Motion; and one Degree of Motion, is 4 Minutes of Time.

Of Foreign Coyn.

Of Spanish Money.

8 Carnados			Mervid.
4 Mervids			Ryal, or 6 *d. Engl.*
1 Ryals	make	1	Ducat.
8 Ryals			Piece of 8 or 4*s. Eng.*
4 Quartiliards			Ryal.

Portugal Money.

10 Res			Ryal, or 6 *d. Engl.*
5 Ryals			Testoon.
2 Testoons, or 10 Ryals	make	1	Ducat.
1½ Ducats			Milt of Gold.

French,

French Money.

12 Deniers 20 Soulx 16 Soulx 4 Carducas	make	1	Soulx. Frank, or Liver. Cardecue. Crown.

Scotch.

1 Small Piece	make	2 *d.* 1 *q. English.*
3 Small Pieces		1 Noble *Scotch*, o 6 *d.* 3 *q. English.*
2 Nobles *Scotch*		1 Mark, or 13 *d.* 2 *q* E
3 Nobles *Scotch*		1 *l. Scotch*, or 20 *d.* E

Irish.

2 *Ob.* or 4 *d.* 2 *q. Eng.* 20 Harpers	is	1 Harper, or 9*d.* E 1 *l. Irish*, 15 *s. Eng*

Flemish.

8 Pence 2 Groats 2 Single Stivers, 20 Single Stivers, or 10 Double 6 Guilders	is	1 Groat. 1 Single Stiver. 1 Double Stiver, o 3 *d.* 1 *q. English.* 1 Guilder. 1 *l.*

Persia

Persian Coyns.

2 Bistees
2 ½ Shawhees } is 1 { Shawhee. Larree. Mammoodee.
2 Shawhees

A TABLE of KINGS
Anno, 1678.

The Kings Names.	Their Birth	Began his Reign.	Reigned Ye.	Mo	D.	Since then Reign began
W. Con	1023	1066 Octo.	14	20	11	22	611 Octo.
W. Rufus	1057	1087 Sept.	9	12	11	19	590 Sept.
Henry 1	1068	1100 Aug.	1	35	04	11	577 Aug.
Stephen	1105	1135 Dec.	2	18	11	19	542 Dec.
Henry 2	1131	1154 Octo.	25	34	09	02	517 Octo.
Richard 1	1155	1189 July	0	09	09	22	488 July
K. John	1166	1199 Apr.	6	17	07	00	478 Apr.
Henry 3	1207	1216 Octo.	19	56	01	00	461 Octo.
Edward 1	1239	1272 Nov.	16	34	08	09	405 Nov.
Edward 2	1283	1307 July	6	19	07	06	370 July
Edward 3	1312	1326 Jan.	25	50	05	07	351 Jan.
Richard 2	1366	1372 June	21	22	03	16	301 June
Henry 4	1367	1399 Sept.	29	13	06	05	278 Sept.
Henry 5	1384	1412 Mar.	20	09	05	24	265 Mar.
Henry 6	1421	1422 Aug.	31	38	06	18	255 Aug.
Edward 4	1442	1460 Mar.	4	12	01	08	217 Mar.
Edward 5	1474	1483 Apr.	9	00	02	18	194 Apr.
Richard 3	1410	1483 June	22	02	02	05	194 July
Henry 7	1455	1485 Aug.	22	23	18	19	192 Aug.
Henry 8	1491	1509 Apr.	22	37	10	02	168 Apr.
Edward 6	1537	1546 Jan.	28	06	05	19	131 Jan.
Q. Mary	1515	1553 July	6	05	04	22	124 July
Q. Eliza.	1533	1558 Nov.	17	44	04	15	119 Nov.
K. James	1566	1602 Mar.	24	22	00	03	075 Mar.
Charles 1	1600	1625 Mar.	27	24	10	06	052 Jan.
Charles 2	1630	1648 Jan.	30	Whom God grant long to

FINIS.